Issued for Construction

Virginia Tech

Virginia Tech Project Code WO# 26-819490
Forestry Research Operations Center

CN Project No. 11053

October 23, 2026

CLARKNEXSEN
A JMT Company

213 South Jefferson, Suite 1011
Roanoke, VA 2401

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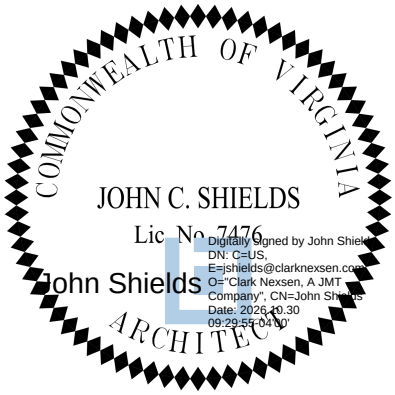
1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect:

1. John C. Shields, AIA.
2. 7476.
3. Responsible for Divisions 00 - 13 except where indicated as prepared by other design professionals of record.



B. Civil Engineer:

1. Johnathan C. Brodie, P.E.
2. 053540.
3. Responsible for Divisions 31, 32, 33 and Section 010200.



C. Structural Engineer:

1. Craig M. Favor, P.E.
2. 39775.
3. Responsible for Division 03.



D. Fire-Protection Engineer:

1. Brandon M. Wilson, P.E.
2. 053738.
3. Responsible for Division 28.



E. Plumbing and Mechanical, HVAC Engineer:

1. Lucas W. Hoffmann, P.E.
2. 042595.
3. Responsible for Division 22 and Division 23.



F. Electrical Engineer:

1. Brandon M. Wilson, P.E.
2. 053738.
3. Responsible for Division 26.



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END OF DOCUMENT 000107

NOTICE OF INVITATION FOR BIDS – IFB #443882703
Forestry Research Operations Center
Blacksburg, VA

Sealed bids are invited for the construction of the Forestry Research Operations Center at Virginia Polytechnic Institute & State University ("Virginia Tech") located in Blacksburg, VA.

The project is generally described as: A single-story pre-engineered metal building of approximately 3,740 square feet, incorporating workshop areas, storage, and two vehicle service bay, with associated plumbing, mechanical, electrical, fire protection, and site work.

Sealed bids will be received electronically through Virginia Tech's electronic procurement submission website:

PROPOSAL SUBMISSION:

***Please note, proposal submission procedures have changed effective March 2023.**

Proposals may NOT be hand delivered to the Procurement Office.

Proposals should be submitted electronically through Virginia Tech's procurement portal. This portal allows you access to view business opportunities and submit bids and proposals to Virginia Tech digitally and securely.

Proposals must be submitted electronically at:
https://bids.sciquest.com/apps/Router/PublicEvent?CustomerOrg=VATech

Vendors will need to register through this procurement portal, hosted by Jaggaer. It is encouraged for all vendors to register prior to the proposal submission deadline to avoid late submissions. Registration is easy and free. If you have any challenges with the registration process, please contact Jaggaer Support at 1-800-233-1121 or procurement@vt.edu.

Click on the opportunity and log in to your vendor account to begin preparing your submission. Upon completion, you will receive a submission receipt email confirmation. Virginia Tech will not confirm receipt of proposals. It is the responsibility of the offeror to make sure their proposal is delivered on time.

Hard copy or email proposals will not be accepted. Late proposals will not be accepted, nor will additional time be granted to any individual Vendor.

Attachments must be smaller than 50MB in order to be received by the University.

The deadline for submitting bids is 2:00 PM on Monday, November 23, 2026, as determined by the electronic procurement site. Bids will be opened publicly and read aloud **beginning at 2:00 PM on Tuesday, November 24, 2026,** via Zoom meeting link provided below:

Meeting Link: https://virginiatech.zoom.us/j/89069484725?from=addon
Meeting ID: 890 6948 4725
Call-In Number: 305-224-1968

A Bid Bond on form CO-10.2 (DGS-30-090) is required.

eVA Vendor Registration: The bidder or offeror shall be a registered vendor in eVA. See the attached **eVA Vendor Registration Requirements.**

Procedures for submitting a bid, claiming an error, withdrawal of bids and other pertinent information are contained in the Instructions to Bidders, which is part of the Invitation for Bids. Withdrawal due to error in bid shall be permitted in accord with Section 9 of the Instructions to Bidders and § 2.2-4330, Code of Virginia. The Owner reserves the right to reject any or all bids.

Subcontracting Plans and SWaM Spend Reporting: Each prime contractor who wins an award in which a provision of a small business subcontracting plan is a condition of the award (see *Instructions to Bidder, item 17*) AND is not

individually certified as a Small Business vendor through the Commonwealth of Virginia SWaM certification program (http://www.sbsd.virginia.gov/certification-division/) shall deliver evidence of compliance with their small business subcontracting plan each time a request for payment is submitted.

Upon completion of the contract, the contractor agrees to furnish with the final request for payment, at a minimum, the following information: name of firm with the DMBE certification number or FEIN number, phone number, total dollar amount subcontracted, category type (small), and type of product or service provided. Payment(s) may be withheld until compliance with the subcontracting spend reporting is received and confirmed. The Owner reserves the right to pursue other appropriate remedies to include, but not be limited to, termination for default.

A template for reporting subcontracting data can be found at:

http://www.procurement.vt.edu/Vendor/vendorlink.html

Reporting of the spend data is encouraged from both SWaM Certified and Non-SWaM Certified subcontractors to the university.

An optional pre-bid conference will be held in-person at 9:00 on Wednesday, November 4, 2026. The purpose of this conference is to allow potential Offerors an opportunity to present questions and obtain clarification relative to any facet of this solicitation. To attend the pre-proposal meeting, please meet at the location below at the stated day/time:

Address: 230 Sterrett Drive
Blacksburg, VA 24061
Sterrett Classroom

The Deadline for Request for Information (RFI) shall be **2:00 PM on Friday, November 11, 2026.** All RFI's must be submitted to the Contracting Officer, Deirdre Curry at currydr11@vt.edu.

The contract shall be awarded on a lump sum basis as follows: The TOTAL BASE BID AMOUNT (including any properly submitted bid modifications) on the Bid Form, and as further described. Notice of Intent to Award will be provided to the apparent low bidder and posted on eVA, Virginia Department of General Services' central electronic procurement website, at https://eva.virginia.gov.

Contractor registration is required in accordance with Section 54.1-1103 of the Code of Virginia. See the Invitation for Bids for additional qualification requirements.

All executive branch agencies are directed to advance Executive Order 35, dated July 3, 2019.

Attachment: eVA Vendor Registration Requirements

INSTRUCTIONS TO BIDDERS

The Invitation For Bids ("IFB") consists of the Notice, these Instructions To Bidders, the Bid Form, the Pre-Bid Question Form, the General Conditions of the Construction Contract, the Supplemental General Conditions (if any), the Special Conditions (if any), the Forms to be used, and the Scope of Work as described by the Plans and Specifications, other documents listed in the Specifications, and any addenda which may be issued, all of which request qualified bidders to submit competitive prices or bids for providing the described work of the Contract.

As used herein, the terms "bidder" and "Contractor" both shall refer to the Person submitting a bid.

eVA Vendor Registration: The bidder shall be a registered vendor in **eVA**. See the **eVA** Vendor Registration Requirements at https://eva.virginia.gov/register-now.html.

1. **CONDITIONS AT SITE OR STRUCTURE**: Bidders shall visit the Site and shall be responsible for ascertaining pertinent local conditions such as location, accessibility, general character of the Site, structure or building, and the character and extent of existing conditions, improvements or work within or adjacent to the Site. No Claims shall be submitted as a result of Bidder's failure to have done so but shall be deemed waived and will not be considered by the Owner. See Section 7 of the General Conditions entitled "Conditions at Site."

2. **EXPLANATIONS TO BIDDERS:** No oral explanation in regard to the meaning of drawings and specifications will be made and no oral instructions will be given before the award of the Contract. The Owner shall not be responsible for any conclusions, assumptions or interpretations made by bidders during the preparation of bids that are contrary to the Drawings and Specifications and their clear intent. Discrepancies, conflicts, errors, omissions or doubts as to the meaning of the Contract Documents shall be communicated in writing to the A/E for interpretation. Bidders **must** use the "Prebid Question Form" provided in the bid documents. Bidders must so act to assure that questions reach the A/E at least six (6) days prior to the time set for the receipt of bids to allow a sufficient time for an addendum to reach **all bidders** before the submission of their bids. If, however, there are two (2) weeks or less between the first bid advertisement and the time set for receipt of bids, then bidders must submit questions so that they reach the A/E no later than three (3) days prior to the time set for receipt of bids. Any interpretation made will be in the form of an addendum to the Specifications which will be forwarded to all bidders, and its receipt shall be acknowledged by the bidder on Bid Forms. If such discrepancies, conflicts, errors, omissions or doubts are reasonably apparent or should have been reasonably apparent to the bidder, and the bidder failed to submit questions to the A/E in the time and manner required herein and the Contract is awarded to the bidder, then any claims shall be deemed waived and the bidder shall not be entitled to additional compensation or time, or entitled to sue the Owner based on such discrepancies, conflicts, errors, omissions, or doubts.

3. **TIME FOR COMPLETION:**

(a) "Time for Completion" shall be designated by the Owner on the Invitation for Bids or other pre-bid documents and shall mean the number of consecutive calendar days following the issuance of the Notice to Proceed which the Contractor has to substantially complete all Work required by the Contract. In some instances, the Time for Completion may be stated in the form of a Contract Completion Date based on a stipulated date of Notice to Proceed.

Unless otherwise specified, the Contractor shall achieve Final Completion within thirty (30) days after the date of Substantial Completion.

(b) When the Notice to Proceed is issued, it will state a Contract Completion Date, which has been set by the Owner based on date of the Notice to Proceed and the Time for Completion.

(c) The Contractor, in preparing and submitting its bid, is required to take into consideration normal weather conditions. Normal weather does not mean statistically average weather but rather means a range of weather patterns which might be anticipated based on weather conditions and events for the past ten (10) years. Normal weather conditions shall be determined from the public historical records available, including the U.S. Department of Commerce, Local Climatological Data Sheets, Oceanic and Atmospheric Administration/Environmental Data and Information Service, National Climatic Center and the National Weather Service. The data sheets to be used shall be for the locality or localities closest to the Site. No additional compensation, costs or damages will be paid to the Contractor because of normal weather conditions, including normal adverse weather to be anticipated during the Project. An extension of time for abnormal adverse weather conditions which directly impact the Work will be considered by the Owner as set forth in the General Conditions.

(d) If the Owner designates the public historical climatological records to be used to establish normal weather patterns, the bidder shall use those records in estimating and preparing its bid. If the Owner requests each bidder to indicate the weather pattern records used in preparation of a bid, each bidder may select the public historical climatological records upon which it will rely in preparing its bid. In the latter situation, each bidder shall designate in the space provided which of such climatological data records were used in preparing the bid. A bidder's failure to designate climatological records when submitting a bid shall not disqualify a bid but shall constitute a waiver of any claim or request for an extension of time as the result of abnormal adverse weather. In either case, the bid submitted and the Time for Completion shall be presumed to have been based upon normal weather patterns, including normal adverse weather, as derived from the climatological records used.

4. PREPARATION AND SUBMISSION OF BIDS:

(a) Bids shall be submitted on the forms furnished, or copies thereof, and shall be signed in ink, or in the case of bids submitted electronically, signatures shall be in accordance with *Code of Virginia § 59.1-479 et seq*. The Owner's agreement to accept electronic bids, if made, will be indicated in the IFB. Erasures or other changes in a bid must be explained or noted over the signature of the bidder. Bids containing any conditions, omissions, unexplained erasures, alterations or items not called for in the proposal, or irregularities of any kind, may be rejected by the Owner as being incomplete or nonresponsive.

(b) Each bid must give the complete legal name and full business address of the bidder and be signed by the bidder, or the bidder's authorized representative. Bids by partnerships must be signed in the partnership name by one of the general partners of the partnership or an authorized representative, followed by the designation/title of the person signing, and a list of the partners. Bids by joint ventures must be signed in the joint venture name by one of the joint venturers or an authorized representative of one of the joint venturers, followed by the designation/title of the person signing, and a list of the joint venturers. Bids by corporations must be signed with the legal name of the corporation followed by the name of the state in which it is incorporated and by the signature and title of the person authorized to bind it in this matter. The name of each person signing shall be typed or printed below the signature. A signature on a bid by a person who identifies their title as "President," "Secretary," "Agent" or other designation without disclosing the principal firm, shall be held to be the bid of the individual signing. When requested by the Owner, satisfactory evidence of the authority of the officer signing on behalf of the corporation shall be furnished. Trade or fictitious names may be referenced by using "t/a _ _ _ ," but bids shall be in the legal name of the person or entity submitting the bid.

(c) Bids with the bid guarantee shall be enclosed in a sealed envelope which shall be marked and addressed as indicated by the advertisement. For any contract, the bidder shall be licensed appropriately in accordance with *Code of Virginia §§ 54.1-1100 et. seq.* for single contract value and total value of all construction, removal, repair, or improvements undertaken by the bidder within any twelve-month period. The bidder shall place on the outside of the envelope containing the bid and shall place in the bid over its signature whichever of the following notations is appropriate and insert its Contractor license/registration number:

Licensed Class A Virginia Contractor No:_____
or
Licensed Class B Virginia Contractor No:_____
or
Licensed Class C Virginia Contractor No:_____

If the Bidder is not properly licensed in Virginia at the time the bid is submitted, or if the bidder fails to provide this information on its bid or on the envelope containing the bid and fails to promptly provide said Contractor license number to the Owner in writing when requested to do so before the opening of bids, the bidder shall be deemed to be in violation of *Code of Virginia §§ 54.1-1100 et. seq.* and its bid will not be considered.

(d) Following guidance from the Board for Contractors, the Owner may, as a part of determining whether the bidder is "responsible," require the apparent low bidder to submit a listing of its Subcontractors along with the license number and classification or specialty of each. *See* DEP'T OF PROF'L AND OCCUPATIONAL REGULATION, BD. FOR CONTRACTORS POLICIES & INTERPRETATIONS, No. 2959 (July 11, 2016) ("A licensed contractor may bid on work, or enter into a contract for work, which is outside the scope of [its] license classification(s) provided that [it] subcontracts that work, to properly licensed contractors, and the work of the subcontractors is incidental to the contract.").

(e) The bidder must place its Employer Identification Number (SSN or FEIN) in the space provided on the Bid Form.

(f) Every bidder organized as a stock or nonstock corporation, limited liability company, business trust, or limited partnership or registered as a registered limited liability partnership must be authorized to transact business in the Commonwealth as a domestic or foreign business entity if so required by Title 13.1 or Title 50 of the *Code of Virginia*, as amended, or as otherwise required by law. Any bidder organized or authorized to transact business in the Commonwealth pursuant to Title 13.1 or Title 50 must include in its bid the identification number issued to it by the State Corporation Commission. Any bidder that is not required to be authorized to transact business in the Commonwealth as a foreign business entity under Title 13.1 or Title 50 or as otherwise required by law shall include in its bid or proposal a statement describing why the bidder is not required to be so authorized. A bidder required to be authorized to transact business in Virginia that fails to provide the required information shall not receive an award unless a waiver of this requirement and of any administrative policies and procedures established to implement *Code of Virginia § 2.2-4311.2* is granted by the chief executive of the Owner.

If awarded the Contract, the bidder shall not allow its existence to lapse or its certificate of authority or registration to transact business in the Commonwealth, if so required under Title 13.1 or Title 50, to be revoked or cancelled at any time during the term of the Contract. Doing so shall be deemed to be a violation of *Code of Virginia § 2.2-4311.2* and the bidder understands and agrees that the Owner may void the Contract if the bidder fails to comply with this provision.

(g). *Code of Virginia § 2.2-4376.2* shall be applicable to the Work of the Contract.

5. BID GUARANTEE:

(a) Any bid (including the Total Base Bid plus all Additive Bid Items) which exceeds five hundred thousand dollars ($500,000) shall be accompanied by a Commonwealth of Virginia Standard Bid Bond, Form CO-10.2, payable to the Owner as obligee in an amount equal to five percent (5%) of the amount of the bid (the "Bid Bond"). The Owner agrees to accept a Bid Bond on which the Surety has utilized electronic signatures and/or electronic notarization if the electronic notarization meets the requirements of *Code of Virginia §§ 47.1-6.1, -7, and -12*, and the Commonwealth of Virginia State Corporation Commission Bureau of Insurance and the Bid Bond contains any SURETY BOND SEAL ADDENDUM established by the Commonwealth of Virginia State Corporation Commission Bureau of Insurance. For construction contracts up to $500,000, where

bid bond requirements have been waived by Owner as stated in the IFB, prospective Contractors may be prequalified in accordance with *Code of Virginia § 2.2-4317.* A Bid Bond may be required for Contracts having bids of up to five hundred thousand dollars ($500,000) if such requirement is stated in the IFB. The Bid Bond must be issued to the bidder indicated on the bid form by a surety company which is legally authorized by the Virginia State Corporation Commission to do surety business in the Commonwealth of Virginia. Such Bid Bond shall guarantee the following: that the bidder will not withdraw its bid during the thirty (30) day period following the date of the opening of bids; that if the bid is accepted, the bidder will enter into the Contract with the Owner described in the IFB; that the bidder can and will submit a properly executed and authorized Standard Performance Bond and Standard Labor and Material Payment Bond on the forms included in the IFB. If the bidder withdraws its bid within the thirty (day) period following bid opening, fails to enter into the Contract, or fails to provide the required Standard Performance Bond and Standard Labor and Material Payment Bond within ten (10) days after the bidder's receipt of notice of acceptance of its bid, the bidder and the bidder's surety shall be jointly and severally be liable to the Owner for the difference between the amount specified in the bidder's bid and such larger amount for which the Owner may contract with another party to perform the work covered by said bid, up to the amount of the bid guarantee of 5% of the bidder's total bid amount, as the damage to the Owner resulting from the bidder's default. See *Code of Virginia § 2.2-4336.*

(b) *Code of Virginia § 2.2-4338* contains provisions allowing for alternative forms of bid security in lieu of a Bid Bond. A bidder's use of an alternative form of Security as listed in C*ode of Virginia § 2.2-4338.B* must be approved by the Owner prior to the bidder's submission of its bid on the Bid Receipt date and time to be accepted in lieu of a Bid Bond.

(c) The Bid Bond or other alternative bid security will be returned to all but the three lowest bidders after the formal opening of bids. The remaining Bid Bonds or bid security will be returned to the bidders after the Owner and the accepted bidder have executed the Contract and the required Standard Performance Bond and the Standard Labor and Material Payment Bond for the Contract have been received and approved by the Owner.

(d) If the Contract and required bonds have not been executed by the accepted bidder within thirty (30) days after the date of the opening of the bids, then the Bid Bond or other bid security of any bidder will be returned upon a bidder's request, provided the bidder has not been notified of the acceptance of its bid prior to the date of such request.

6. WITHDRAWAL OR MODIFICATION OF BIDS: Bids may be withdrawn or modified by written or telefaxed notice received at the designated location from bidders prior to the deadline fixed for bid receipt. E-mail withdrawals and modifications are not acceptable. The withdrawal or modification may be made by the person who signed the bid or by an individual(s) who is authorized by the bidder on the face of the bid. Written modifications may be made on the bid form itself, on the envelope in which the bid is enclosed, or on a separate document. Written modifications, whether the original is delivered or telefaxed, must be signed by the person making the modification or withdrawal. The modification must state specifically what is to be modified and by what amount or it must state the item to be modified and what the corrected amount should be.

7. RECEIPT OF BIDS:

(a) **Bids will be received at or before the date and the hour and in the place and manner stipulated in the IFB as may be modified by subsequent Addenda. If bids are to be received electronically, bids shall be submitted via the electronic bid receipt system specified in the IFB.**

(b) **It is the responsibility of the bidder to assure that its bid and any bid modifications are delivered to the place designated for receipt of bids by the date and hour (deadline) set for receipt of bids. Therefore, it is the bidder's responsibility to take into account all factors which may impact on its bid deliverer / courier's ability to deliver the bid and to implement whatever actions are necessary to have the bid delivered to the proper bid receipt location prior to the**

bid receipt deadline. No bids or bid modifications submitted or offered after the date and hour designated for receipt of bids will be accepted or considered.

(c) The Bid Officer is the Owner's representative designated to receive bids at the time and place noted in the IFB and to open the bids received at the appointed time.

(d) **The official time used for the receipt of responses is determined by reference to the clock designated by the Bid Officer.** The Bid Officer shall determine when the Bid Receipt Deadline has arrived and shall announce that the Deadline has arrived and that no further bids or bid modifications will be accepted. All bids and bid modifications in the possession of the Bid Officer and their assistants at the time the announcement is completed are deemed to be timely, whether or not the bid envelope has been physically date/time stamped or otherwise marked by the time the Bid Officer makes the deadline announcement.

(e) In the event the bid receipt occurs during a period of suspended state business operations, the receipt and opening will be delayed one business day.

8. OPENING OF BIDS:

(a) Bids will be opened at the time and place stated in the IFB or as modified by subsequent Addenda, and their contents publicly announced. The Bid Officer shall decide when the specified time for bid opening has arrived. No responsibility will be attached to any officer or agent for the premature opening of a bid not properly addressed and identified. Bid opening shall be no sooner than twenty-four (24) hours after the time set for receipt of bids.

(b) The provisions of *Code of Virginia § 2.2-4342*, as amended, shall be applicable to the inspections of bids received.

(c) In the event the bid opening occurs during a period of suspended state business operations, the opening will be delayed until the next business day.

9. ERRORS IN BIDS: A bidder may withdraw its bid from consideration if the price bid was substantially lower than the other bids due solely to a mistake therein, provided the bid was submitted in good faith, and the mistake was a clerical mistake as opposed to a judgment mistake, and was actually due to an unintentional arithmetic error or an unintentional omission of a quantity of work, labor or material made directly in the compilation of a bid, which unintentional arithmetic error or unintentional omission can be clearly shown by objective evidence drawn from inspection of original work papers, documents and materials used in the preparation of the bid sought to be withdrawn.

In accordance with *Code of Virginia § 2.2-4330(B)(2)*, the bidder must submit to the Owner its original work papers, documents and materials used in the preparation of the bid within one day after the date fixed for submission of bids. Such work papers must be submitted in an envelope or package separate and apart from the envelope containing the bid and marked clearly as to the contents and shall be delivered to the Owner by the bidder in person or by registered mail prior to the time fixed for the opening of bids and may not be withdrawn until after the two-hour period (referred to later) has elapsed. The bids shall be opened at the time designated in the IFB, as amended by addendum. Bid opening is usually one day following the time fixed by the Owner for the submission of bids, but no sooner. Once the bids have been opened, the bidder shall have two (2) hours after the opening of bids within which to claim in writing any mistake as defined herein and withdraw its bid. The Contract shall not be awarded by the Owner until such two-hour period has elapsed. Such mistake shall be proved only from the original work papers, documents and materials delivered to the Owner prior to bid opening. This procedure in *Code of Virginia § 2.2-4330(B)(2)* shall not apply to when the entire bid is required to be submitted on a unit price basis.

Failure of a bidder to submit its original work papers, documents and materials used in the preparation of its bid on or before the time, date and place required shall constitute a waiver by that bidder of its right to withdraw its bid due to a mistake.

No bid may be withdrawn under this section when the result would be the awarding of the Contract on another bid of the same bidder or of another bidder in which the ownership of the withdrawing bidder is more than five (5%) percent.

No bidder who is permitted to withdraw a bid shall, for compensation, supply any material or labor to or perform any subcontract or other work agreement for the person or firm 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. The person or firm to whom the Contract was awarded and the withdrawing bidder are jointly liable to the Owner in an amount equal to any compensation paid to or for the benefit of the withdrawing bidder without such approval.

If the apparent low bid is withdrawn under authority of this section, the lowest remaining bid shall be deemed to be the low bid on the project.

10. **REJECTION OF BIDS**: The Owner reserves the right to cancel the IFB, to reject any and all bids at its sole discretion when such rejection is in the interest of the Owner, or to reject the bid of any bidder who is determined to be not responsive or not responsible. See *Code of Virginia § 2.2-4319*.

11. **DETERMINATION OF RESPONSIBILITY**

Each bidder shall be prepared, if so requested by the Owner, to present evidence of its experience, qualifications and financial ability to carry out the terms of the Contract.

Prior to award of the Contract, an evaluation will be made to determine if the low bidder has the capability, in all respects, to perform fully the contract requirements and the moral and business integrity and reliability which will assure good faith performance, and who has been prequalified, if required. Factors to be evaluated include, but are not limited to:

(a) sufficient financial ability to perform the contract as evidenced by the bidder's ability to obtain payment and performance bonds from an acceptable surety;

(b) appropriate experience to perform the Work described in the bid documents;

(c) any judgments entered against the bidder, or any officers, directors, partners or owners for breach of a contract for construction;

(d) any substantial noncompliance with the terms and conditions of prior construction contracts with a public body without good cause where the substantial noncompliance is documented; or

(e) a conviction of the bidder or any officer, director, partner, project manager, procurement manager, chief financial officer, or owner in the last five years of a crime relating to

governmental or nongovernmental construction or contracting; and/or

(f) any current debarment of the contractor, any officer, director or owner, from bidding or contracting by any public body of any state, any state agency, or any agency of the federal government.

The Owner reserves the right to disqualify or refuse to accept the bid of any bidder who has been convicted, or entered a plea of guilty or nolo contendere, in any federal or state court to any charge involving any unlawful, corrupt or collusive practice involving a public contract whether federal, state, or local, or who has been determined in any judicial proceeding to have violated any antitrust, bid-rigging or collusive practice statute in connection with any public contract, or against whom such formal criminal prosecution or other judicial proceeding has been initiated.

A bidder who, despite being the apparent low bidder, is determined not to be a responsible bidder shall be notified in writing in conformance with the procedures in *Code of Virginia § 2.2-4359*.

12. **AWARD OF CONTRACT**

(a) **Basis for Contract Award**: The Contract, if awarded, will be awarded to the lowest responsive and responsible bidder, if any, provided its bid is reasonable and it is in the best interest of the Owner to accept it and subject to the Owner's right to reject any and all bids and to waive informality in the bids and in the bidding. The Bid Form contains a multi-part Base Bid and may contain Additive Bid Items. Determination of the lowest responsible bidder, if any, will be based on the Total Base Bid Amount **entered on the Bid Form** including any properly submitted bid modifications plus as many Additive Bid Items taken in sequence as the Owner in its discretion chooses to Award. **Where the sum of the values entered in the multiple parts do not agree with the Total Base Bid amount, the Total Base Bid amount entered on the bid form, including any properly submitted bid modifications, shall take precedence. In the event of a conflict between the amount written in words and the numerals, the amount written in words shall take precedence.**

In the event that the Total Base Bid from the lowest responsible bidder exceeds available funds, the Owner may negotiate the Total Base Bid amount with the apparent low bidder to obtain a Contract Price within available funds, pursuant to *Code of Virginia § 2.2-4318* and Section 12(c) herein.

(b) **Informalities:** The Owner reserves the right to waive any informality in the bids when such waiver is in the interest of the Owner.

(c) **Negotiation With Lowest Responsible Bidder**: If award of the Contract to the lowest responsive and responsible bidder is precluded because of limitations on available funds, under the provisions of Code § 2.2-4318 the Owner reserves the right to negotiate the Total Base Bid amount with the lowest responsive, responsible bidder to obtain a Contract Price within the available funds. This may involve changes in either the features or scope of the work included in the Base Bid. Such negotiations with the apparent low bidder may include reducing the quantity, quality, or other cost saving mechanisms involving items in the Total Base Bid. Negotiations for Additive Bid Items are excluded. The Owner shall notify the lowest responsive and responsible bidder that such a situation exists and the Owner and bidder shall then conduct their negotiations in person, by mail, by telephone or by any means they find convenient. If an acceptable Contract can be negotiated, any changes to the IFB documents agreed upon in the negotiations shall be summarized in a "Post Bid Modification" and included in the Contract. If an acceptable Contract cannot be negotiated, the Owner shall terminate negotiations and reject all bids.

(d) **Notice of Intent to Award or Notice of Award:** The Notice of Award or the Notice of Intent to Award will be posted at the Agency's standard location for posting notices **as shown on the "Notice of Invitation to Bid".** In addition, the Agency may also post such notice on the Agency's Website and/or the DGS central electronic procurement Website. Any bidder who desires to protest the award or decision to award a contract shall submit the protest in writing to the public body no later than ten days after the posting of the Notice of Award or Notice of Intent to Award, whichever comes first. See *Code of Virginia § 2.2-4360*.

13. **CONTRACT SECURITY**: For contracts which exceed five hundred thousand dollars ($500,000), the Standard Performance Bond (CO-10) and the Standard Labor and Material Payment Bond (CO-10.1) shall be required, as specified in the IFB. For construction contracts up to $500,000, where Bid Bond requirements are waived, prospective contractors may be prequalified in accordance with *Code of Virginia § 2.2-4317*. See General Conditions and *Code of Virginia §§ 2.2-4337 and § 2.2-4338*. The Owner reserves the right to require such bonds for contracts up to five hundred thousand dollars ($500,000). If the Owner so elects, the requirement shall be set forth in the IFB.

14. **CERTIFICATION**: The bidder, by its signature on the Bid Form, certifies that neither its organization nor any of its officers, directors, partners or owners is currently barred from bidding on contracts by any Agency of the Commonwealth of Virginia, or any public body or agency of another state, or any agency of the federal government. *See* "Disqualification of Contractors" in the Bid Form.

15. **ETHICS IN PUBLIC CONTRACTING:** The provisions, requirements and prohibitions as contained in *Code of Virginia § 2.2-4367 et seq.,* pertaining to bidders, offerors, contractors, and subcontractors are applicable to this project.

16. **BUILDING PERMITS**: Because this is a Project of the Commonwealth of Virginia, codes or zoning ordinances of local political subdivisions do not apply. However, the Virginia Uniform Statewide Building Code shall apply to the Work and shall be administered by the Building Official for State-owned Buildings. The Building Permit will be obtained and paid for by the Owner. All other permits, local license fees, business fees, taxes, or similar assessments imposed by the appropriate political subdivision shall be obtained and paid for by the Contractor. *See* Section 25 of the General Conditions for utility connection fees and services.

17. **UTILIZATION OF SMALL BUSINESSES**: It is the policy of the Commonwealth of Virginia to maximize the participation of small businesses in state contracting. The participation of these businesses directly and through partnerships, joint ventures, subcontracts and other contractual opportunities may be encouraged for this Project based on the Owner's requirements (if applicable) on the Bid Form. Bidders shall provide a Small Business Procurement Plan in conjunction with their sealed bid. The Small Business Procurement Plan shall identify the bidder's proposed percentage of participation by small businesses in the Total Base Bid amount and is indicated on the Bid Form. An entry on the line for "Contractor's Proposed Small Business Participation" is required for the bid to be considered responsive. If the bidder is a DSBSD certified small business, the proposed percentage of small business participation shall be entered as 100%. A bidder may enter a proposed percentage of small business participation of 0% and be considered responsive unless the Bid Form states that the Owner requires a specific percentage of small business participation, in which case the bidder shall enter a percentage equal to or greater than the Owner's required small business participation percentage for the bid to be considered responsive.

18. **BID DOCUMENTS:** Bid Documents are the property of the Owner and a deposit in an amount as stated in the Invitation for Bids is required for each paper set or for each set provided on removable electronic media as a guarantee of the safe return of the documents within ten (10) days of bid opening. This deposit will be refunded in full on not more than two paper sets or sets provided on removable electronic media to each bidder who submits a Contract bid and who returns the documents in good condition. Refund will be made on paper sets and sets provided on removable electronic media to non-bidders and Subcontractors in the amount of half of the deposit when the sets are returned in good condition within 10 days. A deposit is not required for downloading of electronic construction documents through an FTP site. A non-refundable shipping charge may be required for paper sets or sets provided on removable electronic media if stated in the Notice or the IFB.

19. **GENERAL CONDITIONS:** The General Conditions are incorporated in the bid documents. If a copy of the General Conditions is not included in the bid documents, the bidder may obtain a copy of the current edition of the General Conditions at no cost by written request to the A/E and/or the Agency where the bid documents are obtained. Copies may also be obtained from the DGS Forms Center (available online at https://dgs.virginia.gov/engineering-and-buildings/documents-and-forms/deb).

20. **PREBID CONFERENCE**: See the IFB for requirements for a pre-bid conference and whether such conference is mandatory or optional.

21. **INSPECTION OF BID DOCUMENTS:** Copies of the IFB documents including Plans and Specifications and the General Conditions will be available for inspection at the Agency, at the A/E's office, and at the locations listed in the Notice of the IFB.

22. **DRUG-FREE WORKPLACE REQUIRED:** Bidders are reminded that *Code of Virginia § 2.2-4312* requires that the during the performance of the Contract resulting from this solicitation, the Contractor agrees to: (i) provide a drug-free workplace for the Contractor's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the

Contractor that the Contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every Subcontract or purchase order of over $10,000, so that the provisions will be binding upon each Subcontractor or vendor.

For the purposes of this section, "drug-free workplace" means a site for the performance of work done in connection with a specific Contract awarded to a Contractor in accordance with this solicitation, the employees of whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the contract.

NOTE: These CO-7A, Instructions to Bidders, have been created specifically for the use of agencies of the Commonwealth of Virginia, which may not alter their provisions without the express written approval of the Virginia Department of General Services, Division of Engineering and Buildings. These Instructions to Bidders have significant legal implications and shall not be altered or modified. Nothing in the CO-7A, Instructions to Bidders, shall be amended or deleted or its intent changed, except by an approved and properly issued 'Supplemental Instruction to Bidders'. The Commonwealth makes no representation as to their suitability for any other purpose. Paragraphs which have been added or revised since prior edition are identified with a line to the left of the paragraph.

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DGS-30-384
(Rev. 01/21)

Vendor eVA Registration Requirements

eVA Business-to-Government Vendor Registration, Contracts, and Order: The eVA Internet electronic procurement solution, web site portal www.eVA.virginia.gov, streamlines and automates government purchasing activities in the Commonwealth. The eVA portal is the gateway for vendors to conduct business with state agencies and public bodies. All vendors desiring to provide construction and/or professional services to the Commonwealth shall participate in the eVA Internet e-procurement solution by completing the free eVA Vendor Registration. All bidders or offerors must register in eVA and pay the Vendor Transaction Fees specified below; failure to register will result in their bid/proposal being rejected.

Vendor transaction fees are determined by the date the original purchase order is issued and the current fees can be found on the eVA website at https://eva.virginia.gov/eva-billing.html.

eVA Orders and Contracts: The solicitation/contract will result in one (1) purchase order(s) with the eVA applicable transaction fee assessed for each order.

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BID FORM

DATE: *[Bidder fill in Date]*

PROJECT: VT Forestry Research Operations Center
140 Inventive Lane, Blacksburg, VA
IFB #443882703

To: Virginia Polytechnic Institute and State University
North End Center, Suite 2100
300 Turner Street, NW
Blacksburg, VA 24061

In compliance with and subject to your Invitation for Bids and the documents therein specified, all of which are incorporated herein by reference, the undersigned bidder proposes to furnish all labor, equipment, and materials and perform all work necessary for construction of this project, in accordance with the Plans and Specifications dated October 23,2026, and the Addenda noted below, as prepared by Clark Nexsen, A JMT Company, Roanoke, Virginia for the consideration of the following amount:

BASE BID (including the following parts but excluding work in Additive Bid Items):

PART A.
Lump sum price for construction of the building within a perimeter extending 5 feet from the walls of the building, complete and in accordance with the Plans and Specifications:

PART A = _____ Dollars ($_____).

PART B.
Lump sum price for the sitework beyond the 5 feet building perimeter complete and in accordance with the Plans and Specifications:

PART B = _____ Dollars ($_____).

TOTAL BASE BID AMOUNT (Sum of PARTS A and B) IS:

_____ DOLLARS ($_____)

ADDITIVE BID ITEM 1: Lump sum price for all work to include lean-to roof structure on the north side of the building, including related sitework, foundations, floor slab, and bollards, complete, in accordance with the plans and specifications is:

_____ Dollars ($_____)

ADDITIVE BID ITEM 2: Lump sum price for all work to include lightning protection system, complete, in accordance with the plans and specifications is:

_____ Dollars ($_____)

Contract award will be based on the **TOTAL BASE BID AMOUNT shown above** (including any properly submitted bid modifications) plus as many Additive Bid Items taken in sequence as the Owner in its discretion decides to award. In the event of a conflict between the amount written in words and the numerals, the amount written in words shall take precedence.

The bidder has relied upon the following public historical climatological records:
National Weather Service for Blacksburg, VA.

Code of Virginia, § 2.2-4376.2 shall be applicable to the Work of the Contract.

The undersigned understands that time is of the essence and agrees that the date for Substantial Completion of the entire project shall be on or before June 30, 2027, and Final Completion shall be achieved within 30 consecutive calendar days after the date of Substantial Completion as determined by the A/E.

* * * * * * * * * * * *

Acknowledgment is made of receipt of the following Addenda: _____

_____.

If notice of acceptance of this bid is given to the undersigned within 30 days after the date of opening of bids, or any time thereafter before this bid is withdrawn, the undersigned will execute and deliver a contract in the prescribed form (Commonwealth of Virginia Contract Between Owner and Contractor, Form CO-9) within 10 days after the contract has been presented to him for signature. The required payment and performance bonds, on the forms prescribed, shall be delivered to the Owner along with the signed Contract.

Immigration Reform and Control Act of 1986: The undersigned certifies that it does not and shall not during the performance of the Contract for this project violate the provisions of the Federal Immigration Reform and Control Act of 1986, which prohibits employment of illegal aliens, or knowingly employ an unauthorized alien as defined in the Federal Immigration Reform and Control Act of 1986.

DISQUALIFICATION OF CONTRACTORS: By signing this bid or proposal, the undersigned certifies that this Bidder or any officer, director, partner or owner is not currently barred from bidding on contracts by any Agency of the Commonwealth of Virginia, or any public body or agency of another state, or any agency of the federal government, nor is this Bidder a subsidiary or affiliate of any firm/corporation that is currently barred from bidding on contracts by any of the same. We have attached an explanation of any previous disbarment(s) and copies of notice(s) of reinstatement(s).

Either the undersigned or one of the following individuals, if any, is authorized to modify this bid prior to the deadline for receipt of bids by writing the modification and signing their name on the face of the bid, on the envelope in which it is enclosed, on a separate document, or on a document which is telefaxed to the Owner:

_____

_____

_____

I certify that the firm name given below is the true and complete name of the bidder and that the bidder is legally qualified and licensed by the Virginia Department of Professional and Occupational Regulation, Board for Contractors, to perform all Work included in the scope of the Contract.

Virginia License No.: _____ Bidder: _____
(Name of Firm)

Contractor Class: _____ By:_____
(Signature)

Specialty: _____ Valid until: _____

FEIN/SSN: _____ Title: _____

If General Partnership (List Partners' Names)

_____

_____

_____

_____

Business Address:

_____

_____

_____

_____

Telephone # _____

FAX # _____

If Corporation, affix Corporate Seal &
list State of Incorporation

State: _____

(Affix Seal)

Virginia State Corporation Commission ID No.: _____; or

If Contractor is a foreign business entity not required to be authorized to transact business in the Commonwealth under Titles 13.1 or 50 of the Code of Virginia, or as otherwise required by law, please provide an explanation as to why such entity is not required to be so authorized: _____
_____
_____.

[Agency Small Business Participation Requirement:] *(optional)* *%_____[Agency insert percentage]_____*

Contractor's Proposed Small Business Participation: (required) %__*[Contractor insert percentage]*_____

COMMONWEALTH OF VIRGINIA
STANDARD BID BOND

KNOW ALL MEN BY THESE PRESENTS: That _____, the Contractor ("Principal") whose principal place of business is located at _____ and _____ ("Surety") whose address for delivery of 'Notices' is located at _____ are held and firmly bound unto the Commonwealth of Virginia, _____, the Owner ("Obligee") in the amount of five percent (5%) of the Amount (Total Base Bid plus all Additive Bid Items) Bid by Principal, for the payment whereof, Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for _____

NOW, THEREFORE, the conditions of this obligation are as follows. This Bid Bond shall guarantee that the Principal will not withdraw his bid during the period of thirty (30) days following the opening of bids; that if his bid is accepted, Principal will enter into a formal contract with the Owner in accordance with the Contract Between Owner and Contractor, Form CO-9, included as a part of the Invitation for Bids (IFB Documents); that Principal will submit a properly executed and authorized Standard Performance Bond and Standard Labor and Material Payment Bond on the forms included in the IFB documents; and that in the event of the withdrawal of said bid within said period, or failure to enter into said contract and give said bonds within ten (10) days after Principal has received notice of acceptance of his bid, Principal and Surety shall be jointly and severally liable to the Owner for the difference between the amount specified in said bid and such larger amount for which the Owner may contract with another party to perform the work covered by said bid, up to the amount of the bid guarantee. This amount represents the damage to the Owner of account of the default of the bidder in any particular thereof.

The Surety represents to the Principal and to the Obligee that it is legally authorized to do business in the Commonwealth of Virginia.

Signed and sealed this day of

_____
Contractor / Principal **(SEAL)**

_____ By:_____
Witness Typed Name: _____
Title: _____

_____
Surety **(SEAL)**

By:_____
Attorney-in-Fact
Typed Name: _____

AFFIDAVIT AND ACKNOWLEDGEMENT OF ATTORNEY-IN-FACT

COMMONWEALTH / STATE OF _____)
CITY/COUNTY/TOWN of _____

I, the undersigned notary public, do certify that _____, whose name is signed to the foregoing bid bond in the amount of five percent (5%) of the Total Bid Amount and which names the Commonwealth of Virginia, _____, as Obligee, personally appeared before me today in the above jurisdiction and made oath that he/she is the attorney-in-fact of _____, a _____ corporation which is the Surety in the foregoing bond, that he/she is duly authorized to execute on the above Surety's behalf the foregoing bond pursuant to the Power of Attorney noted above and attached hereto, and on behalf of the surety, he/she acknowledged the foregoing bond before me as the above Surety's act and deed.

She/he has further certified that her/his Power of Attorney has not been revoked.
[Complete if Power is recorded: Clerk's Office: _____;
Deed Book/Page No. or Instrument No.: _____.]

Given under my hand this _____ day of _____.

_____
Notary Public (SEAL)

My name (printed) is: _____
My registration number is: _____
My commission expires: _____

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
(VIRGINIA TECH)
HECO-7

GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT
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1. DEFINITIONS

Whenever used in in the Contract Documents, the following terms have the meanings indicated, which are applicable to both the singular and plural variations thereof:

Agency: The Agency, institution or department which is a party to the Contract. For purposes of the Contract, the term Owner shall include such Agency, whether or not the Agency owns the site or the building.

A/E Services: The entirety of the services required of the A/E pursuant to the A/E's contract with the Owner for the Project.

As-Built Drawings: The As-Built Drawings is a set of all Drawings, Specifications, addenda, approved Shop and setting Drawings, Change Orders and other modifications which are updated by the Contractor throughout the performance of the Work to contemporaneously record all changes and variations made during construction. The representation of such variations shall be neatly and clearly marked in color and shall include such supplementary notes, symbols, legends, and details as may be necessary to clearly show the as-built construction of the Work.

Architect/Engineer ("A/E"): The Virginia licensed Architect or Engineer that contracts with the Owner to provide the A/E Services for the Project. The A/E is a separate contractor and not an agent of the Owner. The term includes any subcontractors, associates or consultants employed by the A/E to assist in providing the A/E Services.

Beneficial Occupancy: The time, following Substantial Completion, at which the Project or portion thereof, is sufficiently complete and systems operational such that the Owner could, after obtaining necessary approvals and certificates, occupy and utilize the space for its intended use. Guarantees and warranties applicable to that portion of the Work begin on the date the Owner accepts and occupies the Project, or a portion thereof, unless otherwise specified in the Supplemental General Conditions or by separate agreement.

Change Order: A document (CO-11) issued on or after the effective date of the Contract which is agreed to by the Contractor and approved by the Owner, and which authorizes an addition, deletion or revision in the Work, including any adjustment in the Contract Price and/or the Contract Completion Date. The term Change Order shall also include initiating and confirming change orders issued pursuant to Section 38(a)(3). A Change Order, once signed by all parties, is incorporated into and becomes a part of the Contract.

Code of Virginia: *Code of Virginia* (1950), as amended. Sections of the Code referred to herein are noted by § xx-xx.

Commissioner of Labor and Industry: The Commonwealth of Virginia Commissioner of Labor and Industry.

Construction: The term used to include new construction, reconstruction, renovation, restoration, major repair, demolition and all similar work upon buildings and ancillary facilities, including any draining, dredging, excavation, grading or similar work upon real property.

Contract: The Contract between Owner and Contractor, (CO-9 series) and the Contract Documents incorporated therein.

Contract Completion Date: The date by which the Work must achieve Substantial Completion. The Contract Completion Date is established in the Notice to Proceed, based on the Time for Completion, or set forth as a specific date in the Contract.

Contract Documents: The Contract and any documents expressly incorporated therein. Such incorporated documents customarily include the bid submitted by the Contractor, the General Conditions, any Supplemental General Conditions, any Special Conditions, the Plans and the Specifications, and all modifications, including addenda and subsequent Change Orders.

Contract Price: The total compensation payable to the Contractor for performing the Work in accordance with the Contract Documents, subject to modification by Change Order.

Contractor: The person or entity with whom the Owner has entered into the Contract for the Work.

Critical Path: The longest continuous sequential duration of dependent activities from the Date of Commencement to the Contract Completion Date that defines the minimum overall time necessary to complete the Project, such that a delay of any activity along the Critical Path will result in a delay of the Contract Completion Date unless the duration of a subsequent activity on the Critical Path is reduced to offset the delay and maintain the Contract Completion Date.

Date of Commencement: The date as indicated in the written Notice to Proceed, the receipt of the earliest Building Permit, or a date mutually agreed to between the Owner and Contractor in writing, whichever is the latest.

Day: Calendar day unless otherwise noted.

Defective: An adjective which, when modifying the word Work, refers to Work that is unsatisfactory, faulty, deficient, does not conform to the Contract Documents or does not meet the requirements of inspections,

standards, tests or approvals required by the Contract Documents, or Work that has been damaged prior to the A/E's recommendation of Final Payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion or Beneficial Occupancy).

DGS: Virginia Department of General Services.

Drawing: A page or sheet of the Plans which presents a graphic representation, usually drawn to scale, showing the technical information, design, location, and dimensions of various elements of the Work. The graphic representations include, but are not limited to, plan views, elevations, transverse and longitudinal sections, large and small scale sections and details, isometrics, diagrams, schedules, tables and/or pictures.

DSBSD: Virginia Department of Small Business and Supplier Diversity.

Emergency: Any unforeseen situation, combination of circumstances, or a resulting state that poses imminent danger to health, life or property.

Field Order: A written order issued by the A/E which clarifies or explains the Plans or Specifications, or any portion or detail thereof, without changing the design, the Contract Price, the Time for Completion or the Contract Completion Date.

Final Completion: Completion and full performance of all Work in accordance with the terms and requirements of the Contract Documents, including the completion of all items identified on punch lists generated through the inspections set forth in Section 44(b) and submission of all information, manuals, warranties and documentation required by the Contract.

Final Completion Date: The date of the Owner's acceptance of the Work following Final Completion.

Final Compliance Report: A report where the Contractor shall certify and report on its compliance with the Small Business Procurement Plan, submitted by the Contractor in its Bid for the Contract, to the Owner through DGS' eVA system

Final Payment: The final payment that the Contractor receives pursuant to the applicable provisions of Section 36, except in the event no final payment is made due to termination of the Contract under either Sections 41 or 42. In the event of a termination for cause under Section 41, the Final Payment shall be when the termination became effective. In the event of a termination for convenience under Section 42, the Final Payment shall be either the payment of compensation for termination that the Contractor receives according to the provisions of Section 42(a), or the Owner's determination that no compensation for termination is due the Contractor under Section 42(a), as the case may be.

Float: The excess time included in a construction schedule to accommodate such items as inclement weather and associated delays, equipment failures, and other such unscheduled events. It is the contingency time associated with a path or chain of activities and represents the amount of time by which the early finish date of an activity may be delayed without impacting the Critical Path and delaying the Contract Completion Date. Any difference in time between the Contractor's approved early completion date and the Contract Completion Date shall be considered a part of the Float.

Float, Free: The time (in Days) by which an activity may be delayed or lengthened without impacting the start day of any successor activity.

Float, Total: The difference (in Days) between the maximum time available within which to perform an activity and the duration of an activity. It represents the time by which an activity may be delayed or lengthened without impacting the Contract Completion Date.

General Conditions: The General Conditions of the Construction Contract (CO-7 series).

Notice: Notice required by the Contract shall be given in writing to the email address or physical delivery location identified in the Contract Documents for receipt of Notice by the receiving party. A Notice is deemed to have been properly given and effective at the time such Notice is: (i) deposited with a nationally recognized overnight delivery service using no more than two (2) business day delivery service for delivery to the Notice address; (ii) hand delivered to the Notice address; (iii) enclosed in a postage prepaid envelope addressed to the Notice address and delivered to a United States Postal Service for delivery by prepaid certified or registered mail; or (iv) sent via email to the email address identified for Notice in the Contract Documents.

Notice to Proceed: A written Notice given by the Owner to the Contractor fixing the date on which the Time for Completion will commence for the Contractor to begin the execution of the Work. The Notice to Proceed will identify the Contract Completion Date if not otherwise established by the Contract.

Owner: The public body with whom the Contractor has entered into the Contract for the Work. The term Owner shall also mean the Agency.

Person: This term includes any individual, corporation, partnership, association, company, business, trust, joint venture, or other legal entity.

Plans: The term used to describe the group or set of project-specific Drawings which are included in the Contract Documents.

Project: The term used instead of the specific or proper assigned title of the entire undertaking which includes, but is not limited to, the Work and the A/E Services.

Project Inspector: One or more persons employed by the Owner to inspect the Work for the Owner and/or to document and maintain records of activities at the Site to the extent required by the Owner. The scope of the Project Inspector's authority with respect to the Contractor is limited to that indicated in Section 16 (e) and (f) of the General Conditions and as supplemented by the Owner in writing to the Project Inspector and to the Contractor.

Project Manager: The Project Manager shall be the Owner's designated representative on the Project. The Project Manager shall be the person through whom the Owner generally conveys written decisions and instructions. All Notices to the Owner and all information required to be conveyed to the Owner shall be conveyed to the Project Manager unless otherwise stated in the Contract. The scope of the Project Manager's authority is limited to that authorized by the Owner. The Owner may change the Project Manager from time to time and may, in the event that the Project Manager is absent, disabled or otherwise temporarily unable to fulfill their duties, appoint an interim Project Manager.

Provide: Shall mean furnish and install ready for its intended use.

Record Drawings: Record Drawings are a final compilation set of drawings showing the "as built" condition of the Work, including all conditions, locations and dimensions based on the Contractor's AsBuilt Drawings. The Record Drawings shall contain the Plans, Specification, Addenda, approved shop drawings, and any other information needed to show the final condition of the work, actual location of piping and utilities, the depths of pilings or caissons if pilings or caissons were in the construction, and the integration of all Change Orders to the Work.

Recycled: Equipment, materials, and accessories which have been previously used and that have been processed to form a new product deemed an equal per Section 26.b.

Service Disabled Veteran-Owned Business: A business that meets the definition of "Service disabled veteran business" as set forth in *Code of Virginia*, § 2.2-4310.

Schedule of Values: That portion of Form CO-12 prepared by the Contractor and acceptable to the Owner which indicates the portion of the Contract Price to be paid for each trade or major component of the Work.

Shop Drawings: The drawings, diagrams, illustrations, schedules, installation descriptions and other data prepared by or for the Contractor to provide detailed information for the fabrication, location, erection, installation, connection and methodology associated with the Work. Shop Drawings are intended to aid in the preparation and installation of materials and to ascertain that the materials proposed by the Contractor conform to the requirements of the Contract Documents.

Site: The location at which the Work is performed or is to be performed.

Small Business: A business certified as a small business by the DSBSD.

Small Business Procurement Plan: The proposed type and percentage of small business participation in the Total Base Bid Amount submitted by the Contractor as part of its Bid.

Special Conditions: That part of the Contract Documents which describes special or additional requirements or procedures applicable to the Project. The Special Conditions do not amend or supersede the General Conditions.

Specifications: That part of the Contract Documents containing the written administrative requirements and the technical descriptions of materials, equipment, construction systems, standards, and workmanship for the Work.

Subcontractor: A person or firm having a direct contract with Contractor or with any other Subcontractor for the performance of the Work. Subcontractor includes any person or firm who provides on-Site labor but does not include a Supplier.

Submittals: All Shop, fabrication, setting and installation drawings, diagrams, illustrations, schedules, samples, and other data required by the Contract Documents which are specifically prepared by or for the Contractor to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a Supplier and submitted by the Contractor to illustrate material or equipment conformance of some portion of the Work with the requirements of the Contract Documents. Submittal as used herein includes Shop Drawings.

Substantial Completion: The stage in the progress of the Work at which the Owner agrees that the Work or a specific portion thereof, is sufficiently complete, in accordance with the Contract Documents, so that it can be utilized by the Owner for the purposes for which it was intended. The Owner at its sole discretion may, after obtaining the necessary approvals and certificates, take Beneficial Occupancy at this time or choose to wait to occupy until after Final Completion is achieved.

Supplemental General Conditions: An amendment or modification which amends or supplements the General Conditions.

Supplier: A manufacturer, fabricator, distributor, supplier or vendor who provides material or equipment for the Project but does not provide on-Site labor.

SWaM/SDV Business: All subcategories of Small Businesses certified by the DSBSD including Micro Business, Minority-Owned Business, Service-Disabled Veteran-Owned Business, Small Business, and/or Women-Owned Business together as a group.

Time for Completion: The number of consecutive Days following the Date of Commencement within which the Contractor must achieve Substantial Completion of the Work in accordance with the Contract Documents.

Total Contract Amount: The total compensation payable to the Contractor for performing the Contract, subject to modification by Change Order.

Underground Facilities: All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which are or have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

Work: The construction and services required by the Contract Documents, whether completed or partially completed, including, but not limited to, furnishing labor, furnishing and incorporating materials and equipment into the Construction. The Work includes the entire completed Construction, or the various separately identifiable parts thereof, required to be provided under the Contract Documents or which may reasonably be expected to be provided as part of a complete, code compliant and functioning system for those systems depicted in the Plans and Specifications.

2. CONTRACT DOCUMENTS

The Contract Documents consist of the Contract and all other documents identified therein as Contract Documents as more precisely defined above.

3. LAWS AND REGULATIONS

a. The Contractor shall comply with the Virginia Uniform Statewide Building Code and all laws, ordinances, rules, regulations and lawful orders of any public authority bearing on the performance of the Work and shall give all notices required thereby. The Contractor shall assure that all Subcontractors and tradespeople who perform Work on the Project are properly licensed by the Department of Professional and Occupational Regulation as required by Title 54.1, Chapter 11, and Article 1 of the *Code of Virginia* and by applicable regulations.

b. This Contract and all other contracts and Subcontracts are subject to the provisions of Article 3, Chapter 4, Title 40.1, *Code of Virginia*, relating to labor unions and the "right to work." The Contractor and its Subcontractors, whether residents or nonresidents of the Commonwealth, who perform any Work related to the Project shall comply with all of the said provisions.

c. IMMIGRATION REFORM AND CONTROL ACT OF 1986: By signing this Contract, the Contractor certifies that it does not and shall not during the performance of this Contract knowingly employ an unauthorized alien as defined in the Federal Immigration Reform and Control Act of 1986, or otherwise violate its provisions.

d. E-VERIFY PROGRAM: Pursuant to *Code of Virginia*, § 2.2-4308.2, any employer with more than an average of 50 employees for the previous 12 months entering into a contract in excess of $50,000 with any agency of the Commonwealth to perform work or provide services pursuant to such contract shall register and participate in the E-Verify program to verify information and work authorization of its newly hired employees performing work pursuant to such public contract. Any such employer who fails to comply with these provisions may be debarred from contracting with any agency of the Commonwealth for a period up to one year. Such debarment may cease upon the employer's registration and participation in the E-Verify program. If requested, the employer shall

present a copy of their Maintain Company page from E-Verify to prove that they are enrolled in E-Verify.

e. In performing the Work under this Contract, the Contractor shall comply with the provisions of all rules and regulations governing safety as adopted by the Safety Codes Commission of the Commonwealth of Virginia and as issued by the Department of Labor and Industry under Title 40.1 of the *Code of Virginia*. Inspectors from the Department of Labor and Industry shall be granted access to the Work for inspection without first obtaining a search or administrative warrant.

f. Building Permit: Because this Project is on Commonwealth of Virginia property, codes or zoning ordinances of local political subdivisions do not apply to Work at the Site. The Virginia Uniform Statewide Building Code applies to the Work and is administered by the Building Official for State-owned buildings and real property. The Building Permit will be obtained and paid for by the Owner. All other permits, local license fees, business fees, taxes, or similar assessments imposed by the appropriate political subdivision and the Department of Environmental Quality shall be obtained and paid for by the Contractor. See Section 25 of these General Conditions for utility connection fees and services.

g. The Contractor shall include in each of its Subcontracts a provision requiring each Subcontractor to include or otherwise be subject to the same payment and interest requirements in Subsections (a), (b), and (c) of Section 37 of these General Conditions with respect to each lower-tier Subcontractor and Supplier.

h. The Contractor, if not licensed as an asbestos abatement contractor in accordance with *Code of Virginia*, § 54.1-514, shall have all asbestos-related Work performed by Subcontractors who are duly licensed as asbestos contractors for the Work required.

i. Lead-Based Paint Activities: If the Contract Documents indicate that lead-based paint is present on existing materials, components, or surfaces, the Contractor shall conform to the following:

1. The requirements set forth in 40 CFR 745.233 – Lead-Based Paint Activities Requirements in selecting and performing the means, methods and procedures for performing the Work. This includes, but is not limited to, training of personnel, lead abatement, encapsulation of lead-containing materials, removal and handling of lead containing materials, and methods of disposal.

2. The requirements for employee protection contained in 29 CFR Part 1926, Subpart D, and the requirements for record-keeping contained 29 CFR Part 1910.

3. The Virginia Department of Labor and Industry's (DLI) Regulation Concerning Certified Lead Contractors Notification, Lead Project Permits and Permit Fees published in the Virginia Administrative Code, 16 VAC25-35, requiring, among other things, that a permit be issued to the lead abatement contractor, or any subsequent regulation issued by DLI pertaining to lead-based paint abatement.

j. If the Contractor violates laws or regulations that govern the Project, the Contractor shall take prompt action to correct or abate such violation and shall indemnify and hold the Owner harmless against any fines and/or penalties that result from such violation. The Contractor also shall indemnify and hold the Owner harmless against any third-party claims, suits, awards, actions, causes of action or judgments, including but not limited to attorney's fees and costs incurred thereunder, that arise or result from Contractor's violation of laws or regulations.

k. If the Work includes any land-disturbing activities, the Contractor shall have on-Site an individual certified by the Department of Environmental Quality as a Responsible Land Disturber in accordance with *Code of Virginia*, § 62.1-44.15:51.

l. Unless otherwise specified in the Supplemental General Conditions, the Contractor is neither required nor prohibited from entering into or adhering to agreements with one or more labor organizations, or otherwise discriminating against Subcontractors for becoming or refusing to become, or remaining signatories to or otherwise adhering to, agreements with one or more labor organizations. This section does not prohibit Contractor or Subcontractors from voluntarily entering into agreements with one or more labor organizations. Both the Agency and Contractor are entitled to injunctive relief to prevent any violation of this section.

This section does not apply to any public-private agreement for any construction in which the private body, as a condition of its investment or partnership with the state agency, requires that the private body have the right to control its labor relations policy and perform all work associated with such investment or partnership in compliance with all collective bargaining agreements to which the private party is a signatory and is thus legally bound with its own employees and the employees of its contractors and subcontractors in any manner permitted by the National Labor Relations Act, 29 U.S.C. § 151 *et seq.*, or the Railway Labor Act, 45 U.S.C. § 151 *et seq.*

This section does not prohibit an employer or any other person covered by the National Labor Relations Act or the Railway Labor Act from entering into agreements or engaging in any other activity protected by law.

This section shall not be interpreted to interfere with the labor relations of persons covered by the National Labor Relations Act or the Railway Labor Act.

4. NONDISCRIMINATION

a. Contractor shall comply with the Federal Civil Rights Act of 1964, as amended, the Virginia Fair Employment Contracting Act of 1975, as amended, the Virginia Human Rights Act, as amended, and the laws of the Commonwealth of Virginia and all Executive Orders in effect at the time of the Work which safeguard individuals from unlawful discrimination in employment.

b. *Code of Virginia* § 2.2-4311 shall be applicable to the Work of the Contract. During the performance of this Contract, the Contractor agrees as follows:

1. The Contractor shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or other basis prohibited by state law relating to discrimination in employment, except where there is a bona fide occupational qualification reasonably necessary to the normal operation of the contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

2. The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the contractor, will state that such Contractor is an equal opportunity employer.

3. Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

4. The Contractor shall include the provisions of the foregoing subparagraphs 1, 2 and 3 in every Subcontract or purchase order over $10,000, so that the provisions will be binding upon each Subcontractor and Supplier.

c. *Code of Virginia*, § 2.2-4201 shall be applicable to the Work of the Contract. During the performance of this Contract, the Contractor agrees as follows:

1. The Contractor shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, or national origin, except where religion, sex or national origin is a bona fide occupational qualification reasonably necessary to the normal operation of the Contractor. The Contractor shall post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause, including the names of all contracting agencies with which the Contractor has contracts over $10,000.

2. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that Contractor is an equal opportunity employer. However, notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this chapter

3. If the Contractor employs more than five (5) employees, the Contractor shall: (i) provide annual training on the Contractor's sexual harassment policy to all Contractor's supervisors and employees providing services in the Commonwealth of Virginia, except such supervisors or employees who are required to complete sexual harassment training provided by the Commonwealth of Virginia Department of Human Resource Management; and (ii) post the Contractor's sexual harassment policy in: (a) a conspicuous public place in each building located in the Commonwealth that the Contractor owns or leases for business purposes; and (b) the Contractor's employee handbook.

4. The Contractor shall include the provisions of the foregoing subparagraph 1, 2 and 3 in every Subcontract and purchase order over $10,000, so that the provisions will be binding upon each Subcontractor and Supplier.

d. Where applicable, the Virginians with Disabilities Act and the federal Americans with Disabilities Act shall apply to the Contractor and all Subcontractors and Suppliers.

e. The Owner does not discriminate against faith-based organizations as defined in *Code of Virginia* § 2.2-4343.1(B).

5. PROHIBITION OF ALCOHOL AND OTHER DRUGS

a. The Contractor shall establish a written policy to maintain and enforce a drug-free workplace, to specify actions that will be taken against persons for violations of the policy, and to require that such policy be binding on each of its employees, Subcontractors, and Suppliers performing Work of the Contract.

b. The Contractor's policy shall prohibit the following acts by all Contractor, Subcontractor, and Supplier personnel at the Site:

1. The manufacture, distribution, dispensation, possession, or use of a controlled substance or marijuana, except possession and medically prescribed use of prescription drugs; and

2. The impairment of judgment or physical abilities due to the use of a controlled substance or marijuana, including impairment from prescription drugs.

c. The Contractor shall post a copy of this policy in a conspicuous place at the Site and assure that all personnel, including potential hires, are advised of the policy. A violation of this policy will be recognized as a breach of Contract and may result in termination of the Contract.

d. The Contractor shall include in all solicitations or advertisements for employees placed by or on behalf of the Contractor that the Contractor maintains a drug-free workplace.

e. The Contractor shall include the foregoing provisions as binding upon each Subcontractor and Supplier in every subcontract or purchase order over $10,000.

f. For the purposes of this section, "drug-free workplace" means a site for the performance of work done in connection with a specific contract awarded to a contractor in accordance with this chapter, the employees of whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the contract.

6. TIME FOR COMPLETION

a. The Contractor shall achieve Substantial Completion on or before the Contract Completion Date. Unless otherwise specified, the Contractor shall achieve Final Completion within thirty (30) Days after the Contract Completion Date.

b. The Contractor acknowledges and agrees that the Owner is relying upon the Time for Completion and Contract Completion Date for planning the use and Beneficial Occupancy of the Work and for all other purposes. If the Contractor fail**s** to achieve Substantial Completion by the Contract Completion Date, the Contractor shall be subject to payment of actual damages incurred by the Owner or liquidated damages, if provided for in the Contract.

c. The Contractor, in submitting its bid or proposal, acknowledges that the Time for Completion is a reasonable duration and period for performing the Work and that it has taken into consideration normal weather conditions for the period of performance. Normal weather does not mean statistically average weather, but rather means a range of weather patterns which might be anticipated based on weather conditions and events for the past ten (10) years. Normal weather conditions shall be determined from the public historical records available, including the U.S. Department of Commerce, Local Climatological Data Sheets, National Oceanic and Atmospheric Administration / Environmental Data and Information Service, National Climatic Center and National Weather Service. The data sheets to be used shall be those for the locality or localities closest to the Site. No additional compensation, costs or damages will be paid to the Contractor because of normal weather conditions, including normal adverse weather to be anticipated during the Project. An extension of time for abnormal adverse weather conditions which directly impact the Work will be considered by the Owner upon under the following conditions, all of which must be strictly complied with and demonstrated by the Contractor:

1. A request for extension of time-based on abnormal adverse weather conditions must be made in writing within fourteen (14) Days of the completion of the calendar month during which the abnormal adverse weather conditions impacted the Work at the Site. The request for additional time shall be substantiated by weather data collected during the period of

delay at the Site. Said data must demonstrate an actual departure from weather conditions that could have been anticipated at the Site during the dates in question.

2. The abnormal adverse weather must have caused a delay to the Contract Completion Date as a result of a delay to the Critical Path as depicted on the accepted "critical path method" schedule or the approved bar graph schedule current at the time of the weather event. No extension will be considered for any portion of any delay which consumes only Float.

3. All of the evidence and data supporting the request (including both historical data and the recordings at the Site during the time of delay) must be furnished to the Owner before the end of the calendar month following the month for which the request is made.

Compliance with the requirements of this section is a condition precedent to the Contractor's entitlement to any change or adjustment to the Contract Completion Date for impacts from abnormal weather conditions.

d. The Contractor's execution of the Contract is a representation and agreement that the Contractor has visited the Site and reviewed the requirements of the bid documents, the Contract Documents, local conditions, availability of materials, equipment, and labor, the reasonable time required for the Owner to respond to Submittals, and any other factors which may affect the performance of the Work, and has taken all these factors into consideration in submitting its bid and executing this Contract.

7. CONDITIONS AT SITE

a. The Contractor shall have visited the Site prior to bidding or submitting its proposal and is totally responsible for having ascertained pertinent local conditions such as location, accessibility and general character of the Site, and the character and extent of existing conditions, improvements and work within or adjacent to the Site. The Contractor shall not submit any claims or any request for adjustments of the Contract Price or Contract Completion Date which result from its failure to consider such conditions.

b. If in the performance of the Work the Contractor encounters (i) hidden physical conditions of a building being modified which are materially different from those ordinarily encountered or generally recognized as inherent in the activities being performed or (ii) subsurface or concealed latent conditions which are materially different from those frequently present in the locality or from those indicated in the Contract Documents, the Contractor shall promptly provide Notice to the Owner and A/E before the conditions are disturbed and not later than seven (7) Days after discovery. The A/E shall promptly review the conditions and propose such changes or adjustments, if any, in the Contract Documents that may be necessary to address the conditions. The Contractor must request any change in the Contract Price or Contract Completion Date for such conditions pursuant to the applicable requirements in Sections 38, 39, and 43 of these General Conditions. Compliance with the requirements of this section is a condition precedent to the Contractor's entitlement to any change or adjustment in the Contract Price or Contract Completion Date as a result of such Site conditions.

c. If the Contractor, during the course of the Work, observes the existence of any material which he knows, should know, or has reason to believe is hazardous to human health, the Contractor shall promptly notify the Owner in writing before the material is disturbed further or the affected work is performed. The Owner will provide the Contractor with instructions regarding the disposition of the material. The Contractor shall not perform any Work involving the material or any Work causing the material to be less accessible prior to receipt of special instructions from the Owner. The Contractor must request any change in the Contract Price or Contract Completion Date for such

conditions pursuant to the applicable requirements in Sections 38, 39 and 43 of these General Conditions. Compliance with the requirements of this section is a condition precedent to the Contractor's entitlement to any change or adjustment in the Contract Price or Contract Completion Date as a result of such Site conditions.

8. CONTRACT SECURITY

a. For contracts with a value exceeding Five Hundred Thousand Dollars ($500,000), the Contractor shall deliver to the Owner or its designated representative, a Commonwealth of Virginia Standard Performance Bond, DGS-30-084 (CO-10) and a Commonwealth of Virginia Standard Labor and Material Payment Bond, DGS-30-088 (CO-10.1), each fully executed by the Contractor and one or more surety companies legally licensed to do business in Virginia and each in an amount equal to one hundred percent (100%) of the Contract Price. If more than one Surety executes a bond, each shall be jointly and severally liable to the Owner for the entire amount of the bond. Sureties shall be selected by the Contractor, subject to approval by the Owner. No payment on the Contract shall be due and payable to the Contractor until the bonds have been approved by the Owner and the Office of the Attorney General of Virginia. To facilitate review of the bonds by the Office of the Attorney General, the power of attorney from the surety company to its agent who executes the bond shall be attached to the bond, or, if not so attached, prior to the execution of the bonds by the surety, recorded in the Office of the Clerk of Court for the City of Richmond, Virginia, at the John Marshall Court Building, 400 North Ninth Street, Richmond, VA 23219.

b. For the purposes of all Standard Labor and Material Payment Bonds entered into, the term "subcontractors" as used in § 2.2-4337(A)(2)of the *Code of Virginia* is interpreted to mean any Subcontractors at any tier who participated in the prosecution of the Work undertaken by the Contractor (referred to in § 2.2-4337(A)(2) of the *Code of Virginia* as the "prime contractor"), whether such Subcontractor had a direct contract with the Contractor (prime contractor) or another Subcontractor, regardless of whether there were one or more other intervening Subcontractors contractually positioned between it and the Contractor (prime contractor).

c. *Code of Virginia* § 2.2-4338 allows for alternative forms of security in lieu of payment and/or performance bonds. No alternative forms of security shall be allowed unless approved in writing by Owner prior to Contractor's submission of its Bid or proposal.

d. Mechanic's liens may not be filed or recorded on Owner, Agency, or Commonwealth property. The Contractor shall keep the Owner's property free and clear from all mechanic's liens. The Contractor shall, upon Notice from the Owner, cause any liens filed or recorded to be released within ten (10) Days from Notice at its cost and expense; and if the Contractor fails to do so, the Owner shall have the right, but not the obligation, to cause such lien to be released by bonding or otherwise, and the Contractor shall indemnify and hold harmless the Owner from all costs and expenses incurred or to be incurred as a result, including bond premiums, court costs and attorneys' fees arising from or related to such liens. At the Owner's option, it may withhold payment of any sums due the Contractor until any such liens are released, and may deduct such costs or expenses from any payment then due or thereafter becoming due from the Owner to the Contractor.

9. SUBCONTRACTS

a. The Contractor shall, as soon as practicable after the signing of the Contract, notify the Owner and A/E in writing of the names of all Subcontractors proposed for the principal parts of the Work and of such others as the A/E may direct. Where the Specifications establish qualifications or criteria for Subcontractors, manufacturers, or individuals performing Work on the Project, the Contractor

shall be responsible for ascertaining that those proposed meet the criteria or qualifications. The Contractor shall not employ any Subcontractor that the Owner may, within a reasonable time, object to as unsuitable. Neither the Owner nor the A/E shall direct the Contractor to contract with any particular Subcontractor unless provided in the Specifications or Invitation for Bids.

b. The Owner may select a particular Subcontractor for a certain part of the Work and designate on the Invitation for Bids or Request for Proposal that the Subcontractor shall be used for the part of the Work indicated and that the Subcontractor has agreed to perform the Work for the subcontract amount stipulated on the bid or Proposal form. The Contractor shall include the stipulated amount plus its markups in the bid or Proposal. In such case, the Contractor shall be responsible for that Subcontractor and its work and the Subcontractor shall be responsible to the Contractor for its work just as if the Contractor had selected the Subcontractor. If the Contractor has a reasonable objection to the Subcontractor designated, then the Contractor shall note the exception in its bid or proposal and the reason for the exception and maintain appropriate provisions for coordinating the work of the Subcontractor. The Owner, at its sole discretion, may accept the Contractor's bid or proposal with the exception noted and contract separately with the Subcontractor under the provisions of Section 10 of the Contract or designate a different Subcontractor.

c. The Owner shall, on request, furnish to any Subcontractor, if practicable, the amounts of payments made to the Contractor, the Schedule of Values and Requests for Payment submitted by the Contractor, and any other documentation submitted by the Contractor which would tend to show what amounts are due and payable by the Contractor to the Subcontractor.

d. The Contractor shall be fully responsible to the Owner for all acts and omissions of its agents and employees and all tiers of Subcontractors and Suppliers performing or furnishing any of the Work. Nothing in the Contract Documents shall create any contractual relationship between Owner or A/E and any Subcontractor, Supplier or other Person, nor shall it create any obligation on the part of Owner or A/E to pay for or to see to the payment of any moneys due any Subcontractor, Supplier or other Person, except as may otherwise be required by law.

e. The Contractor shall be fully responsible for its invitees at the Site and for those of its Subcontractors, Suppliers, and their employees, including any acts or omissions of such invitees.

f. The Contractor agrees that it is responsible for all dealings and coordination with Subcontractors and Suppliers, and their subcontractors, employees and invitees, including, but not limited to, the Subcontractors' or Suppliers' claims, demands, actions, disputes and similar matters unless specifically provided otherwise by the Contract or by statute.

10. SEPARATE CONTRACTS

a. The Owner reserves the right to let other contracts in connection with the Project, the work under which may proceed simultaneously with the execution of this Contract. The Contractor shall afford separate contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work. The Contractor shall cooperate with them and shall take all reasonable action to coordinate its Work with that of separate contractors. If the Owner has listed other separate contracts in the Invitation for Bids or Requests for Proposal which it expects to proceed simultaneously with the Work of the Contractor, and has included the estimated timing of such other contracts in the Invitation for Bids or Requests for Proposal, the Contractor shall integrate the schedule of those separate contracts into its scheduling. The Contractor shall make every reasonable effort to assist the Owner in maintaining the schedules for all separate contracts. If the work performed by a separate contractor is Defective or performed so as to prevent or threaten to prevent the Contractor from carrying out its Work according to the Contract, the Contractor shall immediately notify the Owner and the A/E upon discovering such conditions.

b. If a dispute arises between the Contractor and any separate contractor(s) as to their responsibility for cleaning up the Site, the Owner may clean up and charge the cost thereof to the respective contractors in proportion to their responsibility. If the Contractor disputes the Owner's apportionment of clean-up costs, it shall be the Contractor's burden to demonstrate and prove the correct apportionment.

11. CONTRACTOR'S AND SUBCONTRACTOR'S INSURANCE

a. The Contractor shall not commence Work under this Contract until all insurance required hereunder has been obtained from an insurer authorized to do business in Virginia and such insurance has been approved by the Owner. The Contractor shall provide to the Owner Certificates of Insurance for all required coverage and, upon request, shall provide full copies of the Contractor's insurance policies. Approval of insurance by the Owner shall not relieve or decrease the liability of the Contractor hereunder.

b. The Contractor shall procure and maintain, as required herein, the following insurance coverages:

1. Workers' Compensation and Employer's Liability Insurance to cover all employees engaged in the Work of a type and in an amount to meet all Commonwealth of Virginia statutory requirements and regulations to provide all benefits to which employees may be entitled, with limits no less than $1,000,000 bodily injury by accident or disease, each employee. Where applicable, coverage shall be extended to cover any claims under the United States Longshoreman's Act and Harbor Workers Act and Jones Act as may be appropriate for the work.

2. Comprehensive General Liability insurance, including coverage for Broad Form Contractual, Premises/Operations, Product and Completed Operations, Independent Contractor's Liability, and Personal Injury Liability, with limits of at least $1,000,000 per occurrence and $2,000,000 aggregate, applicable on a per-project basis. The policy shall not exclude or limit the amount of coverage for the Work of the Project or for explosion, collapse, underground operations, mold, or exterior insulation and finish system ("EIFS").

3. Automobile Liability Insurance with a limit of not less than $1 million combined single limit for bodily injury and property damage per occurrence, covering all owned, nonowned, hired and borrowed vehicles, whether on-Site or off-Site.

4. Contractor or the Asbestos Subcontractor shall provide occurrence-based liability insurance with asbestos coverages in an amount not less than **$**1,000,000. The following shall be named as additional insureds on this policy: the Commonwealth of Virginia, its officers, employees and agents; the A/E (if not the Asbestos Project Designer); and the Contractor (where the asbestos work is being performed by the Asbestos Subcontractor).

c. Unless otherwise specified, Contractor shall ensure that all insurance required by Subsection (b) above contains the following provisions:

1. With the exception of Workers' Compensation insurance, the Commonwealth of Virginia, the Owner, and their officers, employees and agents shall be named as additional insureds on all policies. The additional insureds as stated for the asbestos coverage shall be as stated in Section 11(b)(4).

2. All insurance coverage shall be considered primary and non-contributory with respect to other insurance that might be available to the Contractor, A/E, Owner, or Agency.

3. All insurers shall waive rights of subrogation against the Commonwealth of Virginia, Owner and Agency for any claims covered by the insurance required herein.

4. All deductibles or self-insured retentions shall be the sole responsibility of the Contractor.

d. No insurance will be canceled, dropped, replaced, or materially changed without at least thirty (30) Days' prior written Notice to and consent of the Owner.

e. Contractor shall require each Subcontractor to carry the same insurance, and in the same amounts, required by Section 11(b)(1)-(3) above. The Contractor shall not allow any Subcontractor to commence Work on the Project until all insurance required of the Subcontractor by this Contract has been obtained by the Subcontractor and approved by the Contractor.

f. Prior to award of the Contract, the Contractor shall submit, on the form provided by the Owner, a Certificate of Coverage verifying Workers' Compensation insurance is in place. The Contractor shall likewise obtain a Certificate of Coverage for Workers' Compensation insurance from each Subcontractor and shall provide a copy to the Owner prior to the Subcontractor beginning Work at the Project.

12. "ALL RISK" BUILDER'S RISK INSURANCE

a. The Contractor shall procure and maintain, at its cost, all-risk Builder's Risk insurance with minimum coverage and limits as follows:

1. **Contractor Controlled During Construction:** If the Site is controlled by the Contractor during the Project, the Contractor shall maintain "all-risk" Builder's Risk insurance for the Work and the entire structure or structures, if any, on which the Work is to be done with a minimum limit of not less than the insurable value of the structure(s) plus one hundred percent (100%) of the Contract Price and the value of all Change Orders, to represent the total value of the structure(s) and the Work on a replacement cost basis.

2. **Owner Controlled During Construction:** If the Site is controlled by the Owner during the Project, the Owner will maintain insurance coverage on its building(s). The Contractor shall maintain "all risk" Builder's Risk insurance in an amount equal to one hundred percent (100%) of the Contract Price and the value of all Change Orders, to represent the total value of the Work on a replacement cost basis.

b. Builder's risk insurance shall be provided on an "all risk" or equivalent policy form and shall include, without limitation, insurance against all perils. The insurance shall cover the costs of debris removal, temporary buildings, legal requirements, and compensation for A/E services and Contractor services required following an insured loss. The insurance shall cover portions of the Work stored off-Site, Work in transit, and all materials, supplies, equipment, machinery, and fixtures that are or will be part of the Project.

c. Such insurance may include a deductible provision if the Owner so provides in the Supplemental General Conditions, in which case the Contractor will be liable for such deductible whenever a claim arises. Any loss payable under the Builder's Risk insurance shall be payable to the Owner, in accordance with its interests, as they may appear, and then to any other persons insured thereunder.

Written evidence of this insurance and a copy of the policy shall be provided to the Owner no later than thirty (30) Days following the award of the Contract. The policy shall not be canceled, dropped,

replaced, or materially changed without at least thirty (30) Days' prior written Notice to and consent of the Owner.

d. Builder's risk insurance shall include the interest of the Contractor, the Owner, the Commonwealth, and all Subcontractors and Sub-subcontractors. Contractor shall maintain the builder's risk insurance until Final Payment by the Owner or until no person other than the Owner has an insurable interest in the Work, whichever is later.

e. Any insurance provided through the Department of Treasury, Division of Risk Management, on buildings, construction, additions or renovations will not extend to Contractor's nor Subcontractors' buildings, equipment, materials, tools or supplies unless these items are to become property of the Owner upon completion of the Project and the Owner has assumed responsibility for such items at the time of the loss.

13. TAXES, FEES AND ASSESSMENTS

The Contractor shall, without additional expense to the Owner, pay all applicable federal, state, and local taxes, fees, and assessments arising out of the Work, except the taxes, fees and assessments on the real property comprising the Site. If the State Building Official elects to have the local building official inspect the Work as provided by *Code of Virginia* § 36-98.1, the Owner shall pay the resulting fees to the local building official.

14. PATENTS

The Contractor shall obtain all licenses necessary to use any invention, article, appliance, process or technique of whatever kind and shall pay all royalties and license fees. The Contractor shall indemnify and hold harmless the Owner, its officers, agents and employees, against any loss or liability for or on account of the infringement of any patent rights in connection with any invention, process, technique, article or appliance manufactured or used in the performance of the Contract, including its use by the Owner, unless such invention, process, technique, article or appliance is specifically named in the Specifications or Plans as acceptable for use in carrying out the Work. If, before using any invention, process, technique, article or appliance specifically named in the Specifications or Plans as acceptable for use in carrying out the Work, the Contractor has or acquires information that the same is covered by letters of patent making it necessary to secure the permission of the patentee, or other, for the use of the same, the Contractor shall promptly advise the Owner and the A/E. The Owner may direct that some other invention, process, technique, article or appliance be used. Should the Contractor have reason to believe that the invention, process, technique, article or appliance so specified is an infringement of a patent, and fails to inform the Owner and the A/E, the Contractor shall be responsible for any loss or liability due to the infringement.

15. ARCHITECT/ENGINEER'S STATUS

a. The A/E shall have authority to endeavor to secure the faithful performance of the Work by Contractor. The A/E shall review the Contractor's Submittals for conformance to the requirements of the Contract Documents and return copies to the Contractor with appropriate notations. The A/E shall interpret the requirements of the Plans and Specifications and issue Field Orders to the Contractor as may be required. The A/E shall recommend to the Owner suspension of the Work (in whole or in part) whenever such suspension may be necessary to ensure the proper execution of the Work or the requirements of the Contract. The A/E shall have authority to reject, in writing, Work, including material, installation or workmanship, which does not conform to the Contract Documents or is Defective. The A/E shall determine the progress and quality of the Work, subject to the right of the Owner to make an overriding decision to the contrary. Upon request by the Contractor, the

A/E shall confirm, in writing within fourteen (14) Days, any verbal order or determination made by the A/E.

b. The A/E shall have no authority to approve or order changes in the Work which alter the design concept or which call for an extension of the Contract Completion Date or Final Completion or a change in the Contract Price.

c. The Owner shall have the right, but not the duty, to countermand any decision of the A/E and to follow or reject the advice of the A/E, including but not limited to acceptance of the Work, as it deems best in its sole discretion. In those instances where the A/E has been given authority to act, the A/E shall promptly do so, but in the case of disagreement between the A/E and the Owner, the decision of the Owner shall be final. The Contractor shall not be bound by any determination, interpretation or decision of the A/E contrary to the A/E's authority or that is not consistent with the Contract Documents. The party taking issue with the determination, interpretation or decision of the A/E shall give the other party written notice of such fact within fourteen (14) days after the determination, interpretation or decision is communicated by the A/E. In the actual performance of the Work, the Contractor shall proceed in accordance with instructions given by the A/E unless the Owner and the Contractor mutually agree in writing or by Change Order that the Contractor shall proceed otherwise.

d. All orders from the Owner to the Contractor shall either be transmitted through the A/E or communicated directly to the Contractor and the A/E by the Owner.

e. Should the Owner choose to employ another or different A/E, the status of the A/E so employed shall be the same as that of the former A/E.

f. The A/E shall provide a progress report to the Owner and the Contractor after each A/E visit to the Site. The report shall be in writing indicating the date, time of day, weather conditions and the names of the persons representing the A/E who participated in the visit. The report shall advise the Owner of any problems that were noted or observed and shall compare the A/E's observations of the actual progress of the Work with that reported by the Contractor. On the basis of its on-Site observations, the A/E will make every reasonable effort to guard the Owner against delays, defects, and deficiencies in the Work of the Contractor. The A/E shall have the authority to inspect the Work, to note and report Defective Work and deviations from the Contract Documents to the Owner, to reject Work, and to recommend to the Owner the suspension of the Work when necessary to prevent Defective Work from proceeding or being covered.

g. The A/E shall not be responsible for construction means, methods, techniques, sequences or procedures (other than those expressly specified in the Contract Documents), or for safety precautions and programs in connection with the Work. The A/E shall not be responsible for the Contractor's failure to carry out the Contractor's own responsibilities.

h. The A/E generally conveys written decisions and Notices to the Contractor through the Project Manager and shall generally receive information and Notices from the Contractor through the Project Manager unless otherwise agreed. The Owner may delegate from the A/E to the Project Manager certain inspection, verification, acceptance, rejection, and administrative duties and authority, but any such delegation shall be in writing and a copy thereof provided to the Contractor.

i. The provisions of this Section are included as information only to describe the relationship between the Owner, A/E, and Contractor. No failure of the A/E to act in accordance with this Section shall relieve the Contractor from its obligations under the Contract or create any rights in favor of the Contractor against the Owner.

16. INSPECTION

a. All material and workmanship shall be subject to inspection, examination and testing by the Owner, the A/E, the Project Inspector, authorized inspectors and authorized independent testing entities at any and all times during manufacture and/or construction. The A/E and the Owner shall have authority to reject Defective Work and non-conforming material and require its correction. Rejected workmanship shall be satisfactorily corrected and rejected material shall be satisfactorily replaced with proper material without charge therefore, and the Contractor shall promptly segregate and remove the rejected material from the Site. If the Contractor fails to proceed at once with replacement of rejected material and/or the correction of Defective Work, the Owner may replace such material and/or correct such Work and charge the cost to the Contractor, or may terminate the Contract as provided in Section 41 of these General Conditions, the Contractor and surety being liable for any damage to the same extent as provided in Section 41 for termination thereunder.

b. Site inspections, tests conducted on Site and tests of materials gathered on Site which the Contract requires to be performed by independent testing entities shall be contracted and paid for by the Owner. Examples of such tests are the testing of cast-in-place concrete, foundation materials, soil compaction, pile installations, caisson bearings and steel framing connections. The Contractor shall promptly furnish, without additional charge, all reasonable facilities, labor and materials necessary and convenient for making such tests. Except as provided in (d) below, whenever such examination and testing finds Defective Work or non-conforming materials or equipment, the Contractor shall reimburse the Owner for the cost of reexamination and retesting. Although conducted by independent testing entities, the Owner will not contract and pay for tests or certifications of materials, manufactured products or assemblies which the Contract, codes, standards, etc., require to be tested and/or certified for compliance with industry standards such as Underwriters Laboratories, Factory Mutual or ASTM. If fees are charged for such tests and certifications, they shall be paid by the Contractor. The Contractor shall also pay for all inspections, tests, and certifications which the Contract specifically requires the Contractor to perform or to pay, together with any inspections and tests which it chooses to perform for its own purposes, but which are not required by the Contract.

c. Where Work is related to or dependent on Defective Work, the Contractor shall stop such related or dependent Work until the Defective Work is corrected or an alternative solution is presented that is satisfactory to the Owner. Where Work is rejected as Defective, the Contractor shall stop like Work in other areas or locations on the Project until the Owner has approved corrective measures.

d. Should it be considered necessary or advisable by the Owner or the A/E at any time before the Final Completion Date to make an examination of any part of the Work already completed, by removing or tearing out portions of the Work, the Contractor shall promptly furnish all necessary facilities, labor and material to expose the Work to be tested to the extent required. If such Work is found to be Defective in any respect, the Contractor shall bear all the expenses of uncovering the Work, of examination and testing, and of satisfactory reconstruction and correction of the Defective Work. If, however, such Work is found to meet the requirements of the Contract, the actual cost of the Contractor's labor and material necessarily involved in uncovering the Work, the cost of examination and testing, and Contractor's cost of material and labor necessary for replacement of the examined Work including a markup of fifteen (15%) percent for overhead and profit, shall be paid to the Contractor and, if the Contract Completion Date was delayed thereby, a time extension equivalent to the impact on the Critical Path shall be issued by Change Order. Notwithstanding the foregoing, the Contractor shall be responsible for all costs and expenses in removing and replacing the Work if the Contractor had covered the Work prior to any inspection or test required by the Contract Documents or contrary to the instructions of the A/E, Owner, Project Inspector, or Building Official.

The Project Inspector has the authority to recommend to the A/E and the Owner that the Work be suspended when in his or her judgment the Contract Documents are not being followed. Any such suspension shall be continued only until the matter in question is resolved to the satisfaction of the Owner. The cost of any such Work stoppage shall be borne by the Contractor unless it is later determined that the Work in question was in full compliance with the Contract Documents.

e. The Project Inspector has the right and the authority to:

1. Inspect all construction materials, equipment, and supplies for quality and for compliance with the Contract Documents and/or approved shop drawings and Submittals.

2. Inspect workmanship for compliance with the standards described in the Contract Documents.

3. Observe and report on all tests and inspections performed by the Contractor.

4. Recommend rejection of Work which does not conform to requirements of the Contract Documents or is Defective.

5. Keep a record of construction activities, tests, inspections, and reports.

6. Attend all Site construction meetings and inspections held by the Owner and/or the A/E with the Contractor.

7. Check materials and equipment, together with documentation related thereto, delivered for conformance with approved Submittals and the Contract.

8. Check installations for proper workmanship and conformance with shop drawings and installation instructions.

9. Assist in the review and verification of the Form CO-12, Schedule of Values and Certificate for Payment, submitted by the Contractor each month.

10. Do all things for or on behalf of the Owner as the Owner may direct in writing.

f. The Project Inspector has no authority to:

1. Authorize deviations from the Contract Documents;

2. Enter into the area of responsibility of the Contractor's superintendent;

3. Issue directions relative to any aspect of construction means, methods, techniques, sequences or procedures unless specifically required by the Contract Documents or in regard to safety precautions and programs in connection with the Work;

4. Authorize or suggest that the Owner occupy the Project, in whole or in part; or

5. Issue a certificate for payment.

g. The duties of the Project Inspector are for the benefit of the Owner only and not for the Contractor. The Contractor may not rely upon any act, statement, or failure to act on the part of the Project Inspector, nor shall the failure of the Project Inspector to properly perform his or her duties in any

way excuse Defective Work, improper performance of the Work, or noncompliance with the Contract Documents by the Contractor.

17. SUPERINTENDENCE BY CONTRACTOR

a. The Contractor shall have a competent foreman or superintendent, satisfactory to the A/E and the Owner, on the Site at all times during the performance of the Work. The superintendent shall be familiar with and be able to read and understand the Contract Documents and be capable of communicating verbally and in writing with the Owner's representatives, the A/E, and the Contractor's workers. The Contractor shall be responsible for all construction means, methods, techniques, sequences and procedures, for coordinating all portions of the Work except where otherwise specified in the Contract Documents, and for all safety and worker health programs and practices. The Contractor shall notify the Owner, in writing, of any proposed change in foreman or superintendent, including the reason therefore, prior to making such change.

b. The Contractor shall, at all times, enforce strict discipline and good order among the workers on the Project, and shall not employ on the Work, or contract with, any unfit person, anyone not skilled in the Work assigned to him or her, or anyone who will not work in harmony with those employed by the Contractor, the Subcontractors, the Owner or the Owner's separate contractors and their subcontractors or anyone who will not interact appropriately with the public.

c. The Owner may, in writing, require the Contractor to remove from the Site any employee or Subcontractor's employee the Owner deems to be incompetent, careless, not working in harmony with others on the Site, not interacting appropriately with the public, or otherwise objectionable, but the Owner shall have no obligation to do so.

18. CONSTRUCTION SUPERVISION, METHODS AND PROCEDURES

a. The Contractor shall be solely responsible for supervising and directing the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract. The Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures of construction and for coordinating all portions of the Work, except where otherwise specified in the Contract Documents. The Contractor shall not be responsible for the negligence of others in the design or selection of a specific means, method, technique, sequence or procedure of construction expressly required by the Contract. The Contractor is solely responsible to the Owner that the finished Work complies with the Contract Documents.

The Contractor shall be solely responsible for health and safety precautions and programs for workers and others in connection with the Work. No inspection by, knowledge on the part of, or acquiescence by the A/E, the Project Inspector, the Owner, the Owner's employees and agents, or any other Person shall relieve the Contractor from its sole responsibility for compliance with the requirements of the Contract and its sole responsibility for health and safety programs and precautions for the Work.

b. If a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents, the Contractor may furnish or utilize a substitute means, method, sequence, technique or procedure of construction acceptable to the A/E, subject to the Owner's right to disapprove. The Contractor must submit its written request for the substitution to the A/E with sufficient information to allow the A/E to determine that the substitute proposed is equivalent to that indicated or required by the Contract.

c. The Plans and Specifications are divided into several parts, or sections, for convenience only and because the entirety of the Plans and Specifications must be considered and construed as a whole. The divisions of the Plans and Specifications are not intended to control the Contractor in dividing the Work among Subcontractors or to limit the Work performed by any trade. The Contractor shall be solely responsible for the coordination of the trades, Subcontractors and vendors engaged in the Work and for the compensation of the trades, Subcontractors and vendors for the Work performed.

19. SCHEDULE OF THE WORK

a. **General:** The Contractor is responsible for the scheduling and sequencing of the Work, for coordinating the Work, for monitoring the progress of the Work, and for taking appropriate action to keep the Work on schedule to finish on or before the Contract Completion Date. The Contractor may attempt to achieve Substantial Completion before the Contract Completion Date and receive payment in accordance with Section 36 for the Work completed each period. However, the Contract Completion Date shall be used in all schedules and schedule updates as the deadline for which Substantial Completion is to be achieved. The time (in Days) between the Contractor's planned early completion and the Contract Completion Date is part of the Float. Extensions of time allowed pursuant to Sections 38, 39, and 43, the determination of any compensation for compensable delay, and all other matters between the Owner and the Contractor will be determined using the Contract Completion Date, not an earlier Substantial Completion date planned by the Contractor.

Within two (2) weeks after the Contractor signs the Contract, unless otherwise extended by the Owner at the time of the signing, the Contractor shall prepare and submit to the Owner, with a copy to the A/E, a schedule for achieving Substantial Completion by the Contract Completion Date. The preliminary schedule shall be in sufficient detail to show the sequencing of the various trades for each floor level, wing or work area. The Owner will notify the Contractor of any comments on the preliminary schedule within fifteen (15) Days of receipt by the Owner.

A fully complete Project schedule meeting the requirements set forth below in subparagraph (1) or (2), as applicable, must be submitted no later than sixty (60) Days after the Contract is signed by the Owner.

1. For Contracts with a Contract Price less than $1,500,000, a "critical path method" or bar graph schedule may be utilized. The schedule shall indicate the estimated starting and completion dates for each major element of the work and satisfy the requirements of Section 19 (b) below.

2. For Contracts with a Contract Price of $1,500,000 or more, a "critical path method" schedule shall be utilized to control the planning and scheduling of the Work. The "critical path method" schedule shall be the responsibility of the Contractor and shall be paid for by the Contractor and shall satisfy the requirements of Section 19(c) below.

It is the Contractor's responsibility to submit a schedule that shows Substantial Completion of the Work by the Contract Completion Date and completion of any portions of the Work by any interim deadlines established by the Contract.

The Contractor shall allow sufficient time in the schedule for the A/E to conduct all reviews and inspections required under the A/E Contract with the Owner. If the A/E and the Contractor are unable to agree as to what constitutes sufficient time, the Owner shall determine the appropriate duration for such A/E activities.

The Owner and A/E review schedules and schedule-related submittals solely for compliance with the requirements of this Section. The Owner's failure to reject or its acceptance of any schedule,

graph, chart, recovery schedule, updated schedule, plan of action, monthly status report, or similar schedule-related submittals, shall not constitute a representation, admission, or warranty by the Owner, including but not limited to a representation, admission, or warranty that the schedule is feasible or practical or that contents therein are true or accurate, nor shall any such acceptance or failure to reject relieve the Contractor from sole responsibility for completing the Work by the Contract Completion Date.

No progress payments will be payable to the Contractor until after it has submitted a preliminary schedule which is acceptable to the Owner. Neither the second progress payment nor any subsequent payment shall be payable to the Contractor until it has submitted a fully complete Project schedule accepted by the Owner. No subsequent progress payments will be payable to the Contractor unless it submits each monthly Project report required by Section 19(d) in a form accepted by Owner and each recovery schedule required by Owner pursuant to Section 19(e).

Failure to provide a satisfactory preliminary schedule, fully complete Project schedule, or monthly Project report within the time limits stated above shall be a material breach for which the Owner may terminate the Contract in the manner provided in Section 41 of these General Conditions.

b. **Bar Graph Schedule:** Where a bar graph schedule is allowed, it shall be time-scaled in weekly increments, shall indicate the estimated starting and completion dates for each major element of the Work by trade and by area, level, or zone, and shall schedule dates for all salient features and activities, including but not limited to the placing of orders for materials, submission of Shop Drawings and other Submittals for review, approval of Shop Drawings and Submittals by A/E, the manufacture and delivery of material, the testing and the installation of materials, supplies and equipment, and all Work activities to be performed by the Contractor. Each Work activity will be assigned a duration by the Contractor. One Day shall be the time unit used. The bar graph shall establish and show the Critical Path for the Work.

c. **Critical Path Method Schedule:** Where a Critical Path method schedule is required, it shall be in the time-scaled precedence format using the Contractor's logic and time estimates. The Critical Path method schedule shall be drawn or plotted with activities grouped or zoned by Work area or Subcontract rather than random (or scattered) format.

The Critical Path method schedule shall be time-scaled on a weekly basis and shall be drawn or plotted at a level of detail and logic which will schedule all salient features and activities of the Work, including not only the actual construction Work for each trade, but also the submission of Shop Drawings and Submittals for review, approval of Shop Drawings and Submittals by the A/E, placing of orders for materials, the manufacture and delivery of materials, the testing and installation of materials and equipment, and all Work activities to be performed by the Contractor. The Critical Path method schedule shall have no line-item activities longer than thirty (30) Days in duration, and activities shall be included to provide sufficient detail for effectively managing the sequence of the Work. Failure to include any element of Work required for the performance of this Contract shall not excuse the Contractor from completing all Work required within the Time for Completion and by the Contract Completion Date and any interim deadlines established by the Contract. Each Work activity will be assigned a duration by the Contractor.

When completed, the Critical Path method schedule shall be submitted to the A/E and the Owner for review. The Critical Path method schedule will identify and describe each activity, state the duration of each activity, the calendar dates for the early and late start and the early and late finish of each activity, any constraints placed upon the activity, and clearly depict all activities on the Critical Path for the Work. Float and Free Float shall be indicated for all activities. Float, whether Free Float or Total Float, shall not be considered for the exclusive use or benefit of either the Owner or the Contractor, but must be allocated in the best interest of completing the Work by the Contract Completion Date.

On contracts with a price over $5,000,000, each activity on the Critical Path method schedule shall also be attributable to, and correlate with, each activity on the Schedule of Values, the sum of which for all activities shall equal the Contract Price.

When accepted by the Owner and the A/E as compliant with the requirements of this Section, the schedule shall become the baseline Critical Path method schedule for the Project. Acceptance of the schedule by the Owner does not indicate agreement with, nor responsibility for, the proposed or actual duration of any activity or logic shown on the accepted schedule.

d. **Monthly Project Reports:** The Contractor shall review progress of the Work not less than each month, but as often as necessary to properly manage the Project and stay on schedule to finish before the Contract Completion Date. The Contractor shall collect and preserve information on Change Orders, including extensions of time. The Contractor shall evaluate this information and update the latest accepted schedule as often as necessary to finish before the Contract Completion Date. The Contractor shall submit to the A/E along with each Certificate for Payment a copy of the bar graph schedule annotated to show the current progress or, for projects requiring a Critical Path method schedule, a monthly report of the status of all activities. The bar graph schedule or monthly status report submitted with each Certificate for Payment shall show the Work completed to date in comparison with the Work scheduled for completion, including but not limited to the dates for the beginning and completion of the placing of orders and the manufacture, testing and installation of materials, supplies and equipment. The form for these reports shall be approved by the A/E and the Owner prior to submission of the first Certificate for Payment. If any elements of the Work are behind schedule, regardless of whether they may prevent the Work from being completed on time, the Contractor must indicate in writing in the report what measures it is taking and plans to take to bring each such element back on schedule and to ensure that the Work is completed before the Contract Completion Date.

e. **Progress Delay:** Should any of the following conditions exist, the Owner may require that the Contractor prepare, at no extra cost to the Owner, a plan of action and a recovery schedule for completing the Work by the Contract Completion Date:

1. The Contractor's monthly project report indicates delays that, in the judgment of the A/E or the Owner, call into question the Contractor's ability to complete the Work by the Contract Completion Date;

2. The Critical Path method schedule sorted by early finish dates shows the Contractor to be thirty (30) or more Days behind on the Critical Path schedule at any time during the Work, up to thirty (30) Days prior to the Contract Completion Date;

3. The Contractor desires to make changes in the logic or sequencing of Work activities or the planned duration of future activities of the Critical Path method schedule which, in the judgment of the A/E or the Owner, are of a significant departure from those of the baseline schedule or prior schedule updates.

The plan of action and recovery schedule, when required, shall contain a narrative explanation and display how the Contractor intends to regain compliance with the most current and Owner accepted Critical Path method schedule**,** as updated with approved Change Orders, if any.

The plan of action shall be submitted to the Owner for review within two (2) business days of the Contractor receiving the Owner's written request. The recovery schedule, when required, shall be submitted to the Owner within five (5) Days of the Contractor's receiving the Owner's written request.

f. **Early Completion of Project:** The Contractor may attempt to achieve Substantial Completion before the Contract Completion Date. However, such planned early completion shall be for the Contractor's convenience only and shall not create any additional rights of the Contractor or obligations of the Owner under this Contract, nor shall it change the Time for Completion or the Contract Completion Date. The Contractor shall not be required to pay damages to the Owner because of the Contractor's failure to achieve Substantial Completion by any planned earlier date. Likewise, the Owner shall not pay the Contractor any additional compensation for achieving Substantial Completion prior to the Contract Completion Date nor will the Owner owe the Contractor any compensation should the Owner, its officers, employees, or agents cause the Contractor not to achieve Substantial Completion earlier than the Contract Completion Date.

Contractor may request or propose to change the Contract Completion Date to reflect an earlier Substantial Completion date. The Owner may, but is not required to, accept such proposal. However, a change in the Time for Completion or the Contract Completion Date shall be accomplished only by Change Order. If the Contractor's proposal to change the Time for Completion or the Contract Completion Date is accepted, a Change Order will be issued stating that all references in the Contract, including these General Conditions, to the Time for Completion or the Contract Completion Date shall thereafter refer to the date as modified**,** and all rights and obligations, including the Contractor's liability for actual damages, delay damages and/or liquidated damages, shall be determined in relation to the date, as modified.

20. SCHEDULE OF VALUES AND CERTIFICATE FOR PAYMENT

a. Before submittal of the first Certificate for Payment, the Contractor shall prepare for review and approval of the A/E and the Owner the Schedule of Values listed by trades or by Specifications sections for the Work, the total for which equals the Contract Price. Where the Work has multiple parts or phases, the Contractor shall prepare appropriate Schedules of Values to facilitate reviews of Certificate for Payment submitted for each part or phase.

All Certificates for Payment shall be made in the ASTM Uniformat II structure on the Form CO12, Schedule of Values and Certificate for Payment.

b. If the Contractor requests, or intends to request, payment for materials stored in an approved and secure manner, the Schedule of Values must indicate the amount for labor and the amount for materials, and in a supplement thereto must include an itemized list of materials for that trade or Work section. The material breakdown shall be in sufficient detail to allow verification of the quantities required for the Project, the quantities delivered, the Work completed, and the quantities stored on or off-Site.

c. The Contractor shall complete the "Value of Work Completed" portion of the Form CO-12, complete and sign the Contractor's certification, and attach all substantiating material each Certificate for Payment. Such substantiating material includes, but is not limited to, invoices for materials, delivery tickets, timesheets, payroll records, daily job logs/records, and similar materials which, in the opinion of the Owner and the A/E, are necessary or sufficient to justify payment of the amount requested.

d. The labor progress for any task or activity shall be calculated based upon the percentage of Work complete up to fifty percent (50%) of the completion of the task or activity. Thereafter, the evaluation of labor progress will be based upon the effort required to complete that task or activity. The material progress shall be calculated as the invoiced dollar cost of materials used in relation to the amount estimated as necessary to complete a particular element of Work. When calculating material progress, credit shall be given for installed material as well as that stored on the Site and

any material stored off-Site which has been certified by the A/E in accordance with Section 36 of these General Conditions.

e. Should Work included in previous Certificates for Payment, and for which payment has been made, subsequently be identified by tests, inspection, or other means, as Defective or not acceptable or not conforming to the Contract Documents, the "Value of Work Completed" portion of the first Certificate for Payment submitted after such identification shall be modified to reduce the "completed" value of that Work to a percentage reflecting only that work which is not Defective or nonconforming.

21. ACCESS TO WORK

The A/E, the Owner, the Project Manager, the Owner's inspectors and other testing personnel, the Building Official, inspectors from the Department of Labor and Industry, and others authorized by the Owner, shall have access to the Work at all times. The Contractor shall provide proper facilities for access and inspection.

22 SURVEYS AND LAYOUT

a. The Owner shall furnish the Contractor documents showing property lines and the location of existing buildings and improvements at the Site. The Contractor shall provide competent surveying and engineering services to execute the Work and shall be responsible for the accuracy of those surveying and engineering services.

b. The Owner shall provide the general reference points and benchmarks on the Site as required of it by the Plans and Specifications. If the Contractor finds that any previously established reference points have been lost or destroyed, it shall promptly notify the A/E.

c. The Contractor shall protect and preserve the established benchmarks and monuments and shall make no changes in locations without prior written Notice to the A/E and prior written approval from the Owner. Benchmarks and monuments that are lost or destroyed or which require shifting because of necessary changes in grades or locations shall, subject to prior written approval of the Owner, be replaced and accurately located by the Contractor.

23. PLANS AND SPECIFICATIONS

a. The general character and scope of the Work are illustrated and described by the Plans and the Specifications. If the Contractor deems additional detail or information to be needed, the Contractor shall request the same in writing from the A/E. The request shall precisely state the detail or information needed and shall explain why it is needed. The Contractor shall also indicate a date by which the requested information is required. The A/E shall provide by Field Order such further detail and information as is necessary by the date required so long as the date indicated is reasonable. Any additional drawings and instructions supplied to the Contractor shall be consistent with the Contract Documents, shall be true developments thereof, and shall be so prepared that they can be reasonably interpreted as a part thereof. The Contractor shall carry out the Work in accordance with the additional detail drawings and instructions at no additional cost to the Owner and with no time extension.

b. If the Contractor finds a conflict, error, omission, or other discrepancy in the Plans or Specifications, he shall notify the A/E in writing as soon as possible, but before proceeding with any Work that is or may be impacted by the matter. The A/E shall issue a clarification by Field Order to the Contractor stating the correct requirements. If the Contractor deems the Field Order requires additional or extra Work, it shall provide Notice of its request for additional time and/or compensation to the Owner and A/E prior to proceeding with that Work. The Contractor also shall

submit a request for Change Order along with a detailed substantiating cost proposal through the A/E to the Owner within fourteen (14) Days of the receipt of the Field Order or before proceeding with the Work, whichever is earlier.

c. If a conflict, error, omission or other discrepancy in Plans or Specifications was reasonably apparent or with reasonable diligence should have been apparent to the Contractor prior to submitting its bid or Proposal, and the Contractor failed to submit a question to the A/E in the time and manner required by the Instructions to Bidders, then the Contractor shall not be entitled to additional compensation or time or entitled to bring a claim against the Owner based on such conflict, error, omission or other discrepancy. If the Contractor performs any Work, or is delayed in performing any Work, where such Work involves a conflict, error, omission, or other discrepancy in the Plans or Specifications that the Contractor knew about, or with reasonable diligence should have known about, for which the Contractor failed to provide Notice to the A/E and Owner as required, the Contractor shall assume full responsibility for the Work or delay and shall bear all costs attributable to correcting any Work requiring correction or to any delay, and such conflict, error, omission, or other discrepancy shall not be the basis for a claim against or any recovery from the Owner.

d. In case of differences between a small and large scale Drawing, the large scale Drawing shall govern. Where on a Drawing a portion of the Work is drawn out and the remainder is indicated in outline, the parts drawn out shall apply also to all other like portions of the Work.

e. Where the word "similar" appears on a Drawing, it shall be interpreted in its general sense and not as meaning "identical," and all details shall be worked out in relation to their location and their connection with other parts of the Work.

f. Measurements or dimensions shown on the Drawing for Site features, utilities, buildings, structures, or improvements shall be verified at the Site by the Contractor before commencing the Work. The Contractor shall not scale measurements or dimensions from a Drawing. If there are discrepancies among Drawings or the Plans, the Contractor shall notify and request clarification from the A/E before proceeding with the impacted Work. If new Work is to connect to, match with or be provided in existing facilities, buildings, or improvements, the Contractor shall verify the actual existing conditions and necessary dimensions prior to ordering or fabrication of materials or construction.

g. As-Built Drawings: The Contractor shall maintain at the Site for the Owner one copy of the AsBuilt Drawings in good order and marked to record all changes as they occur during construction. These shall be available to the A/E, the Owner, the Project Inspector, the Owner's other inspectors and to the Owner's testing personnel

h. Preparation of Record Drawings: Upon completion of the Work and prior to the final inspection, the Contractor shall deliver to the A/E, for preparation of the Record Drawings, one complete set of "As Built" Drawings depicting the Work in its as-built condition at Final Completion.

24. SUBMITTALS AND PROJECT RECORDS

a. The Contractor shall submit a listing of all Submittals required by the A/E or which the Contractor identifies as necessary, stating the dates for the submission of each Submittal. The listing shall be in a format acceptable to the A/E. The Contractor shall identify all Submittals with the Owner's Project Code Number as required by Section 24(e).

b. Submittals shall be forwarded to the A/E for approval if required by the Specifications or if requested by the A/E or the Owner. No part of the Work dealt with by a Submittal shall be ordered, fabricated or installed by the Contractor, except at its own risk, until the Submittal for that Work has been approved.

Working drawings, Shop Drawings and/or Submittals for fire protection, fire alarm, fire detection and security systems shall be submitted to, and approved by, first the A/E and then the Building Official prior to ordering, fabricating or installing such systems. The Contractor shall be solely responsible for obtaining such approvals. No part of the Work involving such systems shall be ordered, fabricated or installed by the Contractor until such approvals have been obtained.

c. The Contractor shall furnish to the A/E for approval, the name of the manufacturer, the model number, and other identifying data and information respecting the performance, capacity, nature and rating of the machinery and mechanical and other equipment which the Contractor contemplates incorporating in the Work. When Submittals are required by this Contract for materials, the Contractor shall furnish full information concerning the material or articles which the Contractor intends to incorporate in the Work. When required, samples shall be submitted for approval at the Contractor's expense, with all shipping charges prepaid. Machinery, equipment, material and articles installed or used without required approval shall be at the risk of subsequent rejection.

d. Unless otherwise indicated or required by the Specifications, Shop Drawings shall be submitted in the form of one reproducible tracing and three blue-line or black-line prints. Catalog cuts, product data and other non-reproducible literature, except certificates, shall be submitted in six (6) copies minimum, of which three (3) will be retained by the A/E and the remainder will be returned to the Contractor. The Contractor shall maintain one copy of all approved Shop Drawings and Submittals in the construction trailer for use by inspectors. If agreed by the Owner, A/E, and Contractor, Submittals may be provided in electronic format in lieu of hardcopy format.

e. Submittals shall be accompanied by a letter of transmittal which shall list the Project Code Number, the Submittals included, and the date. Submittals shall be complete in every respect and bound in sets. Each Submittal shall be clearly marked to show each item, component and/or optional feature proposed to be incorporated into the Work. Each Submittal shall contain specific references to the sections of the Plans and Specifications to which the item or component that is the subject of the Submittal relates.

f. The Contractor shall check Submittals for compliance with the requirements of the Contract Documents. The Contractor shall clearly note in writing any and all items which deviate from the requirements of the Contract Documents. Reasons for deviation shall be included with the Submittal. The Contractor shall be solely responsible for checking all dimensions and coordinating all materials and trades to **e**nsure that the components or products proposed, individually or in combination, will fit in the space available and that they will be compatible with other components or products provided.

g. After checking each Submittal, the Contractor shall stamp each sheet of the Submittal with the Contractor's review stamp. Data submitted in a bound volume or on one sheet printed on two sides, may be stamped on the front of the first sheet only. The Contractor's review stamp shall be worded as follows:

The equipment and material shown and marked in this Submittal is proposed to be incorporated into this Project, is in compliance with the Contract Plans and Specifications unless otherwise shown in bold-face type or lettering and listed on a page or pages captioned "**DEPARTURES FROM PLANS AND SPECIFICATIONS**", and can be installed in the allocated spaces. Reviewed by _____ Date _____

The person signing the review stamp shall be the person designated in writing by the Contractor as having that authority. The identity of such individual shall be forwarded to the A/E prior to or with the first Submittal. The signature on the review stamp shall be handwritten in ink, or in the case of electronic submittals, electronically signed in accordance with *Code of Virginia* § 59.1-479 *et seq*. Stamped signatures are not acceptable.

h. The Contractor shall forward all Submittals sufficiently in advance of construction activities and requirements to allow sufficient time for checking, correcting, resubmitting and rechecking each Submittal.

i. If a Submittal indicates a departure from the Contract Documents, the A/E may reject the Submittal or recommend it to the Owner, who shall approve or reject it as the Owner, in its sole discretion, sees fit. Any departure from the Contract Documents must be authorized by a Change Order if it results in adjustment of the Contract Price or the Contract Completion Date.

j. The A/E is responsible to the Owner, but not to the Contractor, to verify that the information, equipment and materials depicted in Submittals conform to the design concept and functional requirements of the Plans and Specifications, that the detailed design portrayed in Shop Drawings and proposed equipment and materials shown in Submittals are of the quality specified and will function properly, and that the Submittals comply with the Contract Documents.

k. The Work shall be in accordance with approved Submittals. Approval of the Contractor's Submittals by the A/E does not relieve the Contractor from responsibility for complying with the Contract Documents.

l. The Plans and/or Specifications may indicate that the A/E designed or detailed a portion of the Work-around a particular product. Should a different product be proposed by the Contractor and accepted, all modifications, rerouting, relocations and variations required for proper installation and coordination to comply with the design concept and requirements of the Contract Documents shall be the responsibility of the Contractor and shall be made at no extra cost to the Owner. If the plans were noted as designed or detailed around a particular product and/or if a product is named when a "brand name or equal" requirement has been used, other products may be utilized following Section 26 of these General Conditions.

m. Additional Submittal requirements are shown in the Specifications.

n. Ownership of all materials and documentation including Shop Drawings, BIM models, copies of any calculations and analyses prepared and other Project-specific details of building components created during the Submittal process shall belong exclusively to the Owner. These materials and documentation, whether completed or not, shall be the property of the Commonwealth of Virginia, whether the Work for which they are made is executed or not. The Contractor shall not use these materials on any other work or release any information about these materials without the express written consent of the Owner.

Such material may be subject to public inspection in accordance with the Virginia Freedom of Information Act. Trade secrets or proprietary information submitted by a bidder, offeror, or contractor in connection with a procurement transaction shall not be subject to disclosure under the Virginia Freedom of Information Act, provided the bidder, offeror, or contractor timely invoked the protections of *Code of Virginia* § 2.2-4342(F).

o. The Contractor shall maintain comprehensive records of all documentation produced in the performance of the Work and maintain a records management system to provide for document tracking, organization, storage and archiving of such documentation. The Contractor's records

management system shall provide for the electronic storage and transmission of Project documents and information through one or more of the following methods: (1) web accessible project management software; (2) electronic files shared utilizing removable electronic media; (3) paper copies of documentation; or (4) in such manner agreed to by the Owner and Contractor. Such records shall be retained by the Contractor for a period of five (5) years following the Final Completion Date. The Contractor shall make the project documentation available to the Owner within five (5) Days of request in an orderly, indexed manner to allow individual documents to be easily located and reviewed. The Contractor shall ensure all documentation is kept current and stored in the records management system in a timely manner.

p. The Contractor's Project documentation shall include regular construction photographs to show progress of the Work and items that are or may be the subject of Contractor or Subcontractor claims. The photographer shall label each photograph with, at a minimum, the Project name, building name/number, City, State, name of Contractor/Subcontractor(s) whose work is depicted, date and time the photograph was taken, description of weather conditions, subject matter and viewpoint of the photograph, name of the photographer, and the names of any observers.

25. FEES, SERVICES AND FACILITIES

a. The Contractor shall obtain all permits, except the Building Permit, and pay for all fees and charges necessary for temporary access, public right-of-way blockage or use, temporary connections to utilities, and the use of property (other than the Site) for storage of materials and other purposes, unless otherwise specifically stated in the Contract Documents.

b. Certain projects such as renovations and interior modifications of existing buildings will usually have water and electric service to the building. In those instances, water and electric power, if required for the Work under the Contract, will be furnished by the Owner subject to reasonable use by the Contractor, but only to the extent and capacity of present services. The Contractor shall be responsible for providing required connections, temporary wiring, piping, etc. to these services in a safe manner and in accordance with applicable codes. All temporary wire, pipe, etc. shall be removed before the Substantial Completion inspection. Acceptance by the Contractor of the use of Owner's water and electricity constitutes a release to the Owner of all claims and of all liability to the Contractor for any damages which may result from the use of such utilities and power and water outages or voltage variations.

c. The Owner shall pay any connection charges for permanent utility connections directly to the utility Supplier. The Contractor shall coordinate such connections with the utility Supplier.

d. It is understood that, except as otherwise specifically stated in the Contract Documents, the Contractor, either directly or through its Subcontractors, shall provide and pay for all material, labor, tools, equipment, water, light, power, telephone and other services or facilities of every nature whatsoever necessary to execute completely and deliver the Work before the Contract Completion Date.

e. The Contractor shall provide all required temporary facilities, including Contractor's office space, Owner's Project Inspector's office space (if required by the Specifications), sanitary facilities, and storage space, as required for the operations and the protection of the materials and the Work. Number, sizes and locations shall be subject to approval of the Owner. Sanitary facilities shall be plumbed into an approved waste treatment system or shall be an approved type of chemical toilet and shall be regularly serviced.

26. EQUALS

a. **Brand names:** Unless otherwise stated in the Specifications, the identification of a certain brand, make or manufacturer denotes the characteristics, quality, workmanship, economy of operation and suitability for the intended purpose of the article to be supplied, but does not restrict the Contractor to the specific brand, make, or manufacturer indicated. Rather, the information conveys to the Contractor the general style, type, character and quality of the article to be supplied.

b. **Equal materials, equipment or assemblies:** Whenever in these Contract Documents a particular brand, make of material, device or equipment is shown or specified, such brand, make of material, device or equipment shall be regarded merely as a standard. Any other brand, make or manufacturer of a product, assembly or equipment which in the opinion of the A/E is the equal of that specified, considering quality, capabilities, workmanship, configuration, economy of operation, useful life, compatibility with design of the Work, and suitability for the intended purpose, will be accepted unless rejected by the Owner as not being equal.

c. **Substitute materials, equipment or assemblies:** The Contractor may propose to substitute a material, product, equipment, or assembly which deviates from the requirements of the Contract Documents but which the Contractor deems will perform the same function and have equal capabilities, service life, economy of operations, and suitability for the intended purpose. The proposal must include any cost differentials proposed. The Owner will have the A/E provide an initial evaluation of such proposed substitutes and provide a recommendation on acceptability and indicate the A/E's redesign fee to incorporate the substitution into the Contract Documents. The Owner shall have the right to limit or reject substitutions at its sole discretion.

d. The Contractor shall be responsible for making all changes in the Work necessary to adapt and accommodate any equal or substitute product approved for use by Owner. The necessary changes shall be made at the Contractor's expense.

27. AVAILABILITY OF MATERIALS

If a brand name, material, product, or model number included in the Contract Documents is not available on the present market, alternate equal materials, products or model numbers may be proposed by the Contractor through the A/E for approval by the Owner through the process set forth in Section 26.

28. CONTRACTOR'S TITLE TO MATERIALS

No materials or supplies for the Work shall be purchased by the Contractor, or by any Subcontractor or Supplier, subject to any security interest, installment or sales contract or any other agreement or lien by which an interest in the materials or supplies is retained by the seller or is given to a secured party. The Contractor warrants that it has clear and good title to all materials and supplies used in the Work or for which the Contractor accepts payment in whole or in part.

29. STANDARDS FOR MATERIALS INSTALLATION & WORKMANSHIP

a. Unless otherwise specifically provided in the Contract, all equipment, material, and accessories incorporated in the Work are to be new or Recycled and in first-class condition.

b. Unless specifically approved by the Owner or required by the Contract, the Contractor shall not incorporate into the Work any materials containing asbestos or any material known by the industry to be hazardous to the health of building construction workers, maintenance workers, or occupants, or harmful to other building components, materials or products. If the Contractor becomes aware that a material required by the Contract contains asbestos or other hazardous or harmful materials,

it shall notify the Owner and the A/E immediately and shall take no further steps to acquire or install any such material without first obtaining Owner approval.

c. All workmanship shall be of the highest quality found in the building industry in every respect. All items of Work shall be done by Persons skilled in the particular task or activity to which they are assigned. In the acceptance or rejection of Work, no allowance will be made for lack of skill on the part of Persons performing the Work. Poor or inferior workmanship (as determined by the A/E, the Owner or other inspecting authorities) shall be removed and replaced at Contractor's expense such that the Work conforms to the highest quality standards of the trades concerned, or otherwise corrected to the satisfaction of the A/E, the Owner, and other inspecting authority, as applicable.

d. Where materials, supplies or equipment are supplied with the manufacturer's printed instructions, recommendations, or directions for installation, or where such instructions, recommendations, or directions are available, installation of the items shall be in strict accordance with the manufacturer's printed instructions unless those instructions contradict the Plans or Specifications, in which case the Contractor shall notify the A/E of the inconsistency and obtain written guidance form the A/E before proceeding with any Work involving the item.

e. Where the Specifications or Plans refer to specific codes or standards governing the installation of specified items, installation shall in all cases be in strict accordance with the referenced codes and standards. Where no reference is made to specific codes or standards, installation shall conform to the generally recognized applicable standards for first-class installation of the specific item to be installed. Contractors are expected to be proficient and skilled in their respective trades and knowledgeable of the Codes and Standards of the National Fire Protection Association ("NFPA"), National Electric Code ("NEC"), Occupational Safety and Health Act ("OSHA") and other codes and standards applicable to installations and associated work by trade.

f. Where the manufacturer's printed instructions are not available for installation of specific items, where specific codes or standards are not referenced to govern the installation of specific items, or where there is uncertainty on the part of the Contractor concerning the installation procedures to be followed or the quality of workmanship to be maintained in the installation of specific items, the Contractor shall consult, in advance, with the A/E for approval of the installation procedures or the specific standards governing the quality of workmanship the Contractor proposes to follow or maintain during the installation of the items in question.

g. During and/or at the completion of installation of any items, the tests designated in the Plans or Specifications necessary to assure proper and satisfactory functioning for its intended purpose shall be performed by the Contractor or by its Subcontractor responsible for the completed installation. All costs for such testing are to be included in the Contract Price. If required by the Contract Documents, the Contractor shall furnish prior to final inspection the manufacturers' certificates evidencing that products meet or exceed applicable performance, warranty and other requirements, and certificates that products have been properly installed and tested.

30. WARRANTY OF MATERIALS AND WORKMANSHIP

a. The Contractor warrants that, unless otherwise specified, all materials and equipment incorporated in the Work shall be new or Recycled, in first-class condition, and in accordance with the Contract Documents. The Contractor further warrants that the Work shall be of the highest quality and in accordance with the Contract Documents and shall be performed by Persons qualified at their respective trades.

b. Work not conforming to these warranties shall be considered Defective.

c. This warranty of materials and workmanship is separate and independent from and in addition to any of the Contractor's other guarantees and obligations in th**e** Contract Documents and under Virginia law.

31. USE OF SITE AND REMOVAL OF DEBRIS

a. The Contractor shall:

1. Perform the Work in such a manner as not to interrupt or interfere with the operation of any existing activity on, or in proximity to, the Site or with the Work of any other separate contractor;

2. Store its apparatus, materials, Supplies and equipment in such orderly fashion at the Site of the Work as will not unduly interfere with the progress of its Work or the work of any other separate contractor; and

3. Place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work.

b. The Contractor expressly undertakes, either directly or through its Subcontractor(s), to effect all cutting, filling or patching of the Work required to make the same conform to the Plans and Specifications, and**,** except with the consent of the A/E**,** not to cut or otherwise alter the work of any other separate contractor. The Contractor shall not damage or endanger any portion of the Work or Site, including existing improvements, unless called for by the Contract.

c. The Contractor expressly undertakes, either directly or through its Subcontractor(s), to clean up frequently all refuse, rubbish, scrap materials and debris caused by its operations, to ensure that at all times the Site shall present a neat, orderly and workmanlike appearance. No refuse, rubbish, scrap material or debris shall be left within the completed Work nor buried on the Site, but shall be removed from the Site and properly disposed of in a licensed landfill or otherwise as required by law.

d. The Contractor expressly undertakes, either directly or through its Subcontractor(s), before Final Payment or such prior time as the Owner may require: to remove all surplus material, false Work, temporary structures, including foundations thereof, plants of any description and debris of every nature resulting from its operations and to put the Site in a neat, orderly condition; to thoroughly clean and leave reasonably dust-free all finished surfaces, including all equipment, piping, etc., on the interior of all buildings; and to clean thoroughly all glass installed under the Contract**,** including the removal of all paint and mortar splatters and other defacements.

If the Contractor fails to clean up as required herein, the Owner may do so and charge the costs incurred thereby to the Contractor in accordance with Section 10 (b).

e. The Contractor shall have, on-Site, an employee certified by the Department of Environmental Quality as a Responsible Land Disturber who shall be responsible for the installation, inspection and maintenance of erosion control and stormwater management measures and devices. The Contractor shall identify this employee to the Owner and the A/E in writing prior to any land disturbance on Site. The Contractor shall prevent Site soil erosion, the runoff of silt and/or debris carrying water from the Site, and the blowing of debris off the Site in accordance with the applicable requirements and standards of the Contract and the Virginia Department of Environmental Quality's Erosion and Sediment Control Regulations and the Virginia Stormwater Management Regulations.

32. TEMPORARY ROADS

Temporary roads, if required, shall be established and maintained until permanent roads are accepted, then removed and the area restored to the conditions required by the Contract Documents. Crushed rock, paving and other road materials from temporary roads shall not be left on the Site unless written permission is received from the Owner to bury the same at a location and depth approved by the Owner.

33. SIGNS

The Contractor may, at its option and without cost to the Owner, erect signs acceptable to the Owner on the Site for the purpose of identifying and giving directions to the Project. No signs shall be erected without prior approval of the Owner as to design, content and location.

34. PROTECTION OF PERSONS AND PROPERTY

a. The Contractor expressly undertakes both directly and through its Subcontractors, to take every reasonable precaution at all times for the protection of all Persons and property at or near the Site or which may be affected by the Contractor's Work.

b. The Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Any violation of safety requirements or duties or any potential safety hazard that is known to the Contractor or which is brought to the attention of the Contractor by the A/E, the Owner, or any other Persons shall be immediately abated.

c. The provisions of all rules and regulations governing health and safety as adopted by the Safety Codes Commission of the Commonwealth of Virginia, issued by the Department of Labor and Industry under Title 40.1 of the *Code of Virginia*, shall apply to all Work under this Contract.

d. The Contractor shall continuously maintain adequate protection of all the Work and Site from damage and shall protect the Owner's property from injury or loss arising in connection with the Work. The Contractor shall make good any damage, injury or loss caused by its operations or the Work, except as may be directly and solely due to errors in the Contract Documents or caused by agents or employees of the Owner. The Contractor shall adequately protect adjacent property to prevent any damage to it or loss of use and enjoyment by its owners. The Contractor shall provide and maintain all passageways, guard fences, lights and other facilities for protection of Persons and the Site and the Work as required by public authority, local conditions, or the Contract.

e. In an emergency affecting the health, safety, or life of Persons, or threatening loss or damage to the Work or adjoining property, the Contractor, without special instruction or authorization from the A/E or the Owner, shall act promptly, at its discretion, to prevent such threatened loss or injury. The Contractor shall carry out any instructions or directives issued by the A/E or Owner, to prevent threatened loss or injury, immediately, without appeal. Any additional compensation or extension of time claimed by the Contractor on account of any emergency actions or measures shall be submitted and determined as provided by Section 38.

f. When necessary for the proper protection of the Work, temporary heating of a type compatible with the Work must be provided by the Contractor, at the Contractor's expense, unless otherwise specified.

35. CLIMATIC CONDITIONS

The Contractor shall suspend activity on and protect any portion of the Work that may be subject to damage by climatic conditions.

36. PAYMENTS TO CONTRACTOR

a. Unless otherwise provided in the Contract, the Owner will make partial payments to the Contractor on the basis of a duly certified and approved Schedule of Values and Certificate for Payment (CO-12), showing the estimate of the Work performed during the preceding calendar month or work period, as recommended by the A/E. When evaluating the Contractor's Certificate for Payment, the A/E will consider the value of the Work in place, the value of approved and properly stored materials, the status of the Work in relation to the Contract Completion Date, and the estimated value of the Work remaining to achieve Final Completion. The A/E will schedule a monthly pay meeting to occur no earlier than the 25th day of the month represented by the Certificate for Payment and no later than the 5th day of the following month. The Contractor shall submit its Certificate for Payment so that it is received by the A/E and the Owner's Project Manager at least one work day prior to the date scheduled by the A/E for the monthly pay meeting. The Owner will review the estimate with the A/E and the Contractor at the monthly pay meeting, which shall be considered the receipt date, and may approve to pay any or all of the Certificate for Payment. In preparing estimates, the material delivered to the Site and preparatory Work done shall be taken into consideration, if properly documented as required by Section 20 of these General Conditions, or as may be required by the A/E, so that actual quantities supplied or performed may be verified. Materials or equipment purchased specifically for the Project, but stored off the Site within the Commonwealth of Virginia, may be considered for payment provided all of the following are accomplished prior to the submission of the Certificate for Payment in which payment for such item is requested:

1. The Contractor must notify the Owner in writing, at least ten (10) Days prior to the submission of Certificate for Payment that specific items will be stored off-Site in a designated, secured place within the Commonwealth of Virginia. The Schedule of Values must be detailed to indicate separately both the value of the material and the labor/installation for trades requesting payment for stored materials. By giving such notification and by requesting payment for material stored off-Site, the Contractor warrants that the storage location is safe and suitable for the type of material stored and that the materials are identified as being the property of the Contractor, and agrees that loss of materials stored off the Site shall not relieve the Contractor of the obligation to timely furnish these materials for the Project and to achieve the Contract Completion Date. If the storage location is more than 20 miles from the Site, the Contractor may be required to reimburse the Owner for the cost incurred for travel to the storage location by Owner and/or the A/E to verify the Contractor's Certificate for Payment for materials stored off-Site. A supplementary agreement, acceptable to Owner, shall be required for payment for materials or equipment stored at a location that is not within the Commonwealth of Virginia.

2. Contractor's notification and Certificate of Payment regarding stored materials shall:

   a. Itemize the quantity of such materials and document with invoices showing the cost of said materials;

   b. Indicate the identification markings used on the materials, which shall clearly reference the materials as for the Project;

   c. Identify the specific location of the materials, which must be within reasonable proximity to the Site and within the Commonwealth of Virginia;

   d. Include a letter from the Contractor's Surety which confirms that the Surety on the Performance Bond and the Labor and Material Payment Bond has been

notified of the request for payment of materials stored off the Site and agrees that the materials are covered by the bonds; and

e. Include documentation establishing that the stored materials are covered by allrisk builder's risk insurance in an amount not less than the fair market value of the materials, which insurance shall include the Owner as an additional insured.

3. The A/E shall indicate, in writing, to the Owner that Submittals for materials stored offSite have been reviewed and meet the requirements of the Contract Documents, that the stored materials meet the requirements of the Plans and Specifications, and that such materials conform to the approved Submittals. Should the A/E deem it necessary to visit the storage site to make such review, the Contractor shall bear the costs incurred therewith

4. The Owner, through the A/E, shall notify the Contractor in writing of its decision whether to pay for materials stored off-Site.

5. The Contractor shall notify the Owner in writing, through the A/E, when the materials are to be transferred to the Site and when the materials are received at the Site.

b. Payment will not be made for materials or equipment stored on or off the Site which are not scheduled for incorporation into the Work within the six months next following submission of the Certificate for Payment without the prior written consent of the Owner, which consent may be withheld by the Owner if, in the Owner's sole discretion, it is not necessary to procure the materials more than six months in advance of use to assure their availability when needed.

c. No payment shall be made to the Contractor until:

1. The Contractor furnishes to the Owner its Social Security Number (SSN), if an individual, or its Federal Employer Identification Number (FEIN), if a proprietorship, partnership, corporation or other legal entity.

2. Certificates of Insurance and required evidence of compliance by the Contractor with all the requirements of Section 11 and Section 12, if applicable, have been delivered to the Owner.

3. Certificates of Insurance and required evidence of compliance by each Subcontractor with the requirements of Section 11 and Section 12, if applicable, have been delivered to the Owner for payments based on Work performed by a Subcontractor.

4. The Contractor has: (i) submitted a preliminary schedule which is acceptable to the Owner in accordance with Section 19(a); (ii) submitted a fully complete Project schedule accepted by the Owner in accordance with Section 19(a); (iii) submitted all monthly Project reports required by Section 19(d); and (iv) timely provided a recovery schedule pursuant to Section 19(e), if requested by the Owner.

d. The Owner shall withhold five percent (5%) of each progress payment to the Contractor until the Final Payment, unless otherwise provided by any law, regulation or program of the federal government. Such retainage shall be held to assure faithful performance of the Contract and may also be used as a fund to deduct amounts due to or claimed by the Owner, including, but not limited to, payment to the Owner of all moneys due for deductive change orders, credits, uncorrected Defective Work, interest, damages, and the like. (*Code of Virginia* § 2.2-4333). The Owner may, at its sole discretion, agree on an item by item basis to release the retainage on items which are fully 100% complete and which have been accepted by the Owner as being tested and complete and on

which no further action or work will be required. Retainage which is released by the Owner shall be distributed by the Contractor in conformance with Section 37.

e. All material and Work for which progress payments are made shall thereupon become the sole property of the Owner, but this provision shall not relieve the Contractor from the sole responsibility for all materials and Work, including those for which payment has been made, or for the restoration of any damaged materials or Defective Work. No payment shall waive any right of the Owner to require Contractor to fulfill all of the terms and conditions of the Contract Documents

f. The Final Payment, which shall include the retainage, less any amounts due to or claimed by the Owner, shall not become due until the A/E and the Owner agree that Final Completion has been achieved and until the Contractor shall deliver to the Owner through the A/E a Certificate of Completion by the Contractor (CO-13.2) and an Affidavit of Payment of Claims (CO-13), stating that all Subcontractors and Suppliers of either labor or materials have been paid all sums claimed by them for Work performed and materials furnished in connection with this Project less retainage. Amounts due the Owner which may be withheld from the Final Payment may include, but are not limited to, amounts due pursuant to Section 3(i), Section 16(a)-(d), Section 31(d), costs incurred to repair or replace Defective Work, costs incurred as a result of the Contractor's negligent acts or omissions or omissions of those for whom the Contractor is responsible, delay damages under Section 43(h), and any liquidated or actual damages.

If all Subcontractors and Suppliers of labor and materials have not been paid the full amount claimed by them, the Contractor shall list each to which an agreed amount of money is due or which has a claim in dispute. With respect to all such Subcontractors and Suppliers, the Contractor shall provide to the Owner, along with the Affidavit of Payment of Claims (CO-13), an affidavit from each such Subcontractor and Supplier stating the amount of their Subcontract or supply contract, the percentage of completion, the amounts paid to them by the Contractor and the dates of payment, the amount of money still due if any, any interest due the Subcontractor or Supplier, and whether satisfactory arrangements have been made for the payment of said amounts. If no agreement can be reached between the Contractor and one or more Subcontractors or Suppliers as to the amounts owed to the Subcontractors or Suppliers, the Owner may, in its discretion, interplead such portion of the moneys due to the Contractor which is claimed by the Subcontractor or Supplier into a Virginia Court or Federal Court sitting in Virginia, in the manner provided by law. Said interpleader and payment into court shall be deemed a payment to the Contractor. Nothing in this Section shall be construed as creating any obligation or contractual relationship between the Owner and any Subcontractor or Supplier, and the Owner shall not be liable to any Subcontractor or Supplier on account of any failure or delay of the Owner in complying with the terms hereof.

g. Upon successful completion of the final inspection and all Work required by the Contract, including but not limited to the delivery of Record Drawings, equipment manuals, written warranties, acceptance of the Work by the Owner and the delivery of the affidavits required in Section 36(f), the A/E shall deliver the written Certificate of Completion by the A/E (CO-13.1) to the Owner, with a copy to the Contractor, stating the entire amount of Work performed and compensation earned by the Contractor. The Owner may accept the Work for occupancy or use while asserting claims against the Contractor, disputing the amount of compensation due to the Contractor, disputing the quality of the Work, disputing Final Completion, disputing Contractor's compliance with the Contract Documents, or any other reason**.**

h. Unless there is a dispute about the compensation due to the Contractor, Defective Work, quality of the Work, compliance with the Contract Documents, Final Completion, claims by the Owner, other matters in contention between the parties, or unless monies are withheld pursuant to the Comptroller's Debt Setoff Program, within thirty (30) Days after receipt and acceptance of the Certificate for Payment in proper form by the A/E at the monthly pay meeting, the Owner shall pay to the Contractor the amount approved by the A/E, less all prior payments and advances

whatsoever to or for the account of the Contractor. In the case of Final Payment, the completed Affidavit of Payment of Claims (CO-13), the Certificate of Completion by the Contractor (CO13.2) and the Certificate of Completion by the A/E (CO-13.1) shall accompany the final Certificate for Payment which is forwarded to the Owner for payment. The date on which payment is due shall be referred to as the Payment Date. Payment shall be mailed on or before the
Payment Date for amounts and Work not in dispute, subject to any set offs claimed by the Owner; provided, however in instances where further appropriations are required by the General Assembly or where the issuance of further bonds is required, in which case, payment shall be made within thirty (30) Days after the effective date of such appropriation or within thirty (30) Days after the receipt of bond proceeds by the Owner. All prior estimates and payments, including those relating to extra Work, may be corrected and adjusted in any payment and shall be corrected and adjusted in the Final Payment. In the event that any Certificate for Payment contains a defect or impropriety, the Owner shall notify the Contractor of any defect or impropriety which would prevent payment by the Payment Date within five (5) Days after receipt of the Certificate for Payment by the Owner from the A/E.

i. Interest shall accrue on all amounts owed by the Owner to the Contractor which remain unpaid seven (7) Days following the Payment Date. Said interest shall accrue at the discounted ninetyday U.S. Treasury bill rate as established by the Weekly Auction and as reported in the publication entitled The Wall Street Journal on the weekday following each such Weekly Auction. During the period of time when the amounts due to the Contractor remain unpaid following the seventh (7) Day after the Payment Date, the interest accruing shall fluctuate on a weekly basis and shall be that established by the immediately prior Weekly Auction. It shall be the responsibility of the Contractor to gather and substantiate the applicable weekly interest rates to the satisfaction of the Owner and to calculate to the satisfaction of the Owner the interest due. In no event shall the rate of interest charge exceed the rate of interest charged pursuant to *Code of Virginia* § 58.11812. No interest shall accrue on retainage or when payment is delayed because of a dispute or disagreement between the Owner and the Contractor regarding the quantity, quality or timeliness of the Work, including, but not limited to, compliance with Contract Documents or the accuracy of any Certificate for Payment. This exception to the accrual of interest stated in the preceding sentence shall apply only to that portion of a payment which is withheld and shall apply only for the duration of the dispute. Nothing contained herein shall be interpreted to prevent the withholding of retainage to assure faithful performance of the Contract. These same provisions relating to payment of interest to the Contractor shall apply also to the computation and accrual of interest on any amounts due from the Contractor to the Owner for deductive change orders and to amounts due on any claims by the Owner. The date of mailing of any payment by the U.S. Mail is deemed to be the date of payment to the addressee. No interest penalty shall be paid to any debtor on any payment, or portion thereof, withheld pursuant to the Comptroller's Debt Setoff Program, as authorized by the Virginia Debt Collection Act (§ 2.2-4800 *et seq.*), commencing with the date the payment is withheld. If, as a result of an error, a payment or portion thereof is withheld, and it is determined that at the time of setoff no debt was owed to the Commonwealth, then interest shall accrue at the rate specified above on amounts withheld that remain unpaid after seven Days following the Payment Date. Unless otherwise provided under the terms of this Contract, interest shall accrue at the rate of one percent per month.

j. The acceptance by the Contractor of the Final Payment shall be and operate as a release to the Owner of all claims by the Contractor, its Subcontractors and Suppliers, and of all liability to the
Contractor whatever, including liability for all things done or furnished in connection with the Work, except for things done or furnished which are the subject of unresolved claims for which the Contractor has filed a timely written Notice of intent and all other Notices and documentation required by the Contract Documents and provided a claim is submitted no later than sixty (60) Days after Final Payment. Acceptance of any interest paid by the Contractor shall be a release of the Owner from claims by the Contractor for late payment.

k. No Certificate for Payment authorized by the A/E, and no payment, final or otherwise, no certificate of completion, nor partial or entire use or occupancy of the Work by the Owner, shall be an acceptance of any Work or materials not in accordance with th**e** Contract, nor shall the same relieve the Contractor of responsibility for nonconforming materials or Defective Work, or operate to release the Contractor or its Surety from any obligation under the Contract**,** the Standard Performance Bond and the Standard Labor and Material Payment Bond.

37. PAYMENTS BY CONTRACTOR (*Code of Virginia,* § 2.2-4354)

Under *Code of Virginia* § 2.2-4354, the Contractor is obligated to:

a. Within seven (7) Days after receipt of amounts paid to the Contractor by the Owner for Work performed by the Subcontractor or Supplier under this Contract, the Contractor shall:

1. Pay the Subcontractor or Supplier for the proportionate share of the total payment received from the Owner attributable to the Work performed by the Subcontractor or the materials furnished by the Supplier under this Contract; or

2. Notify the Owner and the Subcontractor or Supplier, in writing, of the Contractor's intention to withhold all or a part of the Subcontractor or Supplier's payment with the reason for nonpayment.

b. The Contractor shall pay interest to its Subcontractor or Supplier on all amounts owed by the Contractor that remain unpaid after seven (7) Days following receipt by the Contractor of payment from the Owner for Work performed by the Subcontractor or materials furnished by the Supplier, except for amounts withheld as allowed under subsection (a) (2) of this Section.

c. The Contractor shall include in each subcontract a provision requiring the Subcontractor to include in each of its subcontracts a provision requiring each of its subcontractors to include or otherwise be subject to the same payment and interest requirements with respect to each lower-tier subcontractor. Each Subcontractor shall include with its invoice to, or request for payment from, the Contractor, a certification that that Subcontractor has paid each of its suppliers and lower-tier subcontractors their proportionate share of previous payments received from the Contractor attributable to the Work performed or the materials furnished by it under this Contract.

The Contractor's obligation to pay interest to the Subcontractor or Supplier pursuant to subsection (b) of this Section is not an obligation of the Owner. A modification to this Contract shall not be made for the purpose of providing reimbursement for such interest charge. A Contractor's cost reimbursement claim shall not include any amount for reimbursement of any interest charge.

38. CHANGES IN THE WORK

a. The Owner may at any time, by written order utilizing the Change Order (CO-11) and without Notice to the sureties, make changes in the Work which are within the general scope of the Contract, except that no change will be made which alone will increase the total Contract Price to an amount more than twenty percent (20%) in excess of the original Contract Price without Notice to sureties. At the time of the Preconstruction Meeting described in Section 50(b), the Contractor and the Owner shall advise each other in writing of their designees authorized to accept and/or approve Change Orders and of any limits to each designee's authority. Should any designee change or the limits of their authority change, the party initiating such change in designee or authority shall give written Notice to the other Party and the A/E within seven (7) Days. The Contractor agrees and understands that the authority of the Owner's designee is limited by *Code of Virginia*, § 2.2-4309 and any other applicable statute.

Change Orders shall be effective when signed by both parties, unless Governor approval (or by his or her designee) is required, in which event the Change Order shall be effective when signed by the Governor or his or her designee.

In any Change Order adjusting the Contract Price, the increase or decrease in the Contract Price shall be determined by one of the following methods as selected by the Owner:

1. **Fixed Price:** By a mutually agreed fixed amount adjustment to the Contract Price. The Change Order shall be substantiated by documentation from the Contractor itemizing the estimated quantities and costs of all labor, materials, and equipment required as well as any mark-up used. Any increase in the Contract Price shall include the Contractor's reasonable overhead and profit, including overhead for any unreasonable delay arising from or related to the Change Order and/or the change in the Work. See Subsections (d), (e) and (f), below.

2. **Unit Price:** By using unit prices and calculating the number of net units of Work in each part of the Work which is changed, either as the Work progresses or before Work on the change commences, and by then multiplying the calculated number of units by the applicable unit price set forth in the Contract or multiplying by a mutually agreed unit price if none was provided in the Contract. No additional percentage markup for overhead or profit shall be added to the unit prices.

3. **Cost Reimbursement:** The Owner may require the Contractor to perform change in the Work on a cost-reimbursement basis by issuing two Change Orders citing this Subsection: (a) an initiating Change Order, authorizing the changed Work; and (b) a confirming Change Order approving any adjustment in the Contract Price or the Contract Completion Date as a result of the change in the Work. The initiating Change Order shall:

    a. Describe the scope or parameters of the change in the Work;

    b. Describe the cost items to be itemized and verified for payment and the method of measuring the quantity of work performed;

    c. Address the impact on the Critical Path and any adjustment to the Contract Completion Date;

    d. Order the Contractor to proceed with the change to the Work;

    e. Order the Contractor to keep in a form acceptable to the Owner, an accurate, itemized account of the actual cost of the change in the Work, including, but not limited to, the actual costs of labor, materials, equipment, and supplies;

    f. Order the Contractor to annotate a copy of the Project schedule to accurately show the status of the Work at the time the initiating Change Order is issued, to show the start and finish dates of the changed Work, and the status of the Work when the changed Work is completed; and

    g. State that a confirming Change Order will be issued to reflect any increase or decrease to the Contract Price and any change in the Contract Completion Date directly resulting from the change in the Work.

    The Contractor shall sign the initiating Change Order acknowledging it will proceed with the change in the Work. The Contractor's signature on an initiating Change Order citing

this Subsection 38(a)(3) shall not constitute the Contractor's agreement on the cost or time impact of the change in the Work.

Except as otherwise may be agreed to in writing by the Owner, costs incurred due to a change in the Work pursuant to this subsection 38(a)(3) shall not exceed those prevailing for the trades or crafts (based upon rates established by the U.S. Department of Labor, Bureau of Labor Statistics, or other generally recognized cost data publication), materials, and equipment in the locality of the Project, may include only those items listed as allowable in Subsection 38(e), and shall not include any of the costs listed as not allowable in Subsection 38(f). The Owner shall be permitted, on a daily basis, to verify the Contractor's cost records and may require such additional records as are necessary to determine the cost of the change to the Work.

Within fourteen (14) Days after the completion of the change in the Work, the Contractor and the Owner shall review and reconcile all cost records and schedule information regarding the change in the Work. The parties shall prepare a confirming Change Order addressing: (i) any change in the Contract Price resulting from the change in the Work, based on the records kept and the Contractor's allowance for overhead and profit determined in accordance with the provisions set forth in Subsections 38(d), (e), and (f) below; and (ii) any change in the Contract Completion Date as a result of the change in the Work's impact on the Critical Path. If agreement on the confirming Change Order is not reached within the fourteen (14) Day period following completion of the change in the Work, the Contractor may submit a claim for the disputed cost or time as provided for in Section 47.

4. The Owner may issue a unilateral Change Order for any change in the Work stating the change in the Contract Price and/or change in the Contract Completion Date deemed appropriate by the Owner for the Work. If the Contractor objects to adjustments reflected in the unilateral Change Order, the Contractor may submit a claim for the disputed costs or time as provided for in Section 47.

b. The Contractor shall review any Owner proposed change in the Work and shall respond in writing within fourteen (14) calendar Days after receipt of the proposed change (or such other reasonable time as the Owner may direct), stating the effect of the proposed change upon its Work, including any increase or decrease in the Contract Price or Contract Completion Date that the Contractor requests as a result of the proposed change. The Contractor shall furnish to the Owner an itemized breakdown of the quantities and prices used in computing the proposed change in Contract Price. Any change in the Contract Completion Date shall be justified as set forth in Subsection 38(g).

The Owner shall review the Contractor's proposal and respond to the Contractor within thirty (30) days of receipt. If a change to the Contract Price and Contract Completion Date are agreed upon, both parties shall sign the Change Order. If a revised Contract Price and/or Contract Completion Date are not agreed upon, the Owner may direct the Contractor to proceed pursuant to Subsections 38(a)(3) or 38(a)(4).

c. In figuring changes, any instructions for measurement of quantities set forth in the Contract shall be followed.

d. Overhead and profit for both additive and deductive changes in the Work (other than changes covered by unit prices) shall be paid by applying the specified percentage markups only on the net cost of the changed Work (i.e. difference in cost between original and changed Work excluding overhead and profit). Said percentages for overhead and profit shall reasonably approximate the

Contractor's overhead and profit, but shall not exceed the percentages for each category listed below:

1. If a Subcontractor does all or part of the changed Work, the Subcontractor's mark-up for overhead and profit on the Work it performs shall be a maximum of fifteen percent (15%). The Contractor's mark-up for overhead and profit on the Subcontractor's price shall be a maximum of ten percent (10%).

2. If the Contractor does all or part of the changed Work, its markup for overhead and profit on the changed Work it performs shall be a maximum of fifteen percent (15%).

3. If a Sub-subcontractor at any tier does all or part of the changed Work, the Subsubcontractor's markup on that Work shall be a maximum of fifteen percent (15%). The markup for overhead and profit on a Sub-subcontractor's Work by the Contractor and all intervening tiers of Subcontractors shall not exceed a total of ten percent (10%).

4. Where Work is deleted from the Contract prior to commencement of that Work without substitution of other similar Work, one hundred percent (100%) of the Contract Price attributable to that Work shall be deducted from the Contract Price. However, in the event that equipment, product or material Submittals have been approved and orders placed for said equipment, products or materials, a lesser amount, but in no case less than eighty percent (80%) of the Contract Price attributable to that Work, shall be deducted from the Contract Price. The credit to the Owner for reduced premiums on Standard Labor and Material Payment Bonds and Standard Performance Bonds shall in all cases be one hundred percent (100%).

e. Allowable costs for changes in the Work may include but are not limited to the following:

1. Labor costs for employees directly employed in the change in the Work, including salaries and wages plus the cost of payroll charges and fringe benefits and overtime premiums, if such premiums are explicitly authorized by the Owner.

2. Materials incorporated into the change to the Work, including costs of transportation and storage, if applicable. If applicable, all cash discounts shall accrue to the Contractor, unless the Owner deposits funds with the Contractor to make such payments. All trade discounts, rebates**,** refunds, and returns from the sale of surplus materials shall accrue to the Owner.

3. Equipment incorporated in the changed Work or equipment used directly in accomplishing the Work. If rented expressly for accomplishing the change in the Work, the cost shall be the rental rate according to the terms of the rental agreement, which the Owner shall have the right to approve. If owned by the Contractor, the costs shall be a reasonable price based upon the life expectancy of the equipment and the purchase price of the equipment. If applicable, transportation costs may be included.

4. Costs of increases in premiums for the Standard Labor and Material Payment Bond and the Standard Performance Bond, provided coverage for the cost of the change in the Work results in such increased costs. At the Owner's request, the Contractor shall provide proof of his notification to the Surety of the change in the Work and of the Surety's agreement to include such change in its coverage. The cost of the increase in premium shall be an allowable cost but shall not be marked up.

5. Contractor and Subcontractor overhead costs as set forth in Subsection (d) markups above.

6. **Agreed Compensation for Overhead for Changes to Time for Completion or Contract Completion Date for Changes to the Work:** If the change in the Work also changes the Contract Completion Date by adding Days to complete the Work, an itemized accounting of the following direct Site overhead and home office overhead and other indirect overhead expenses set forth in subparagraphs (a) and (b) below may be considered as allowable costs for compensation in addition to those shown above:

   a. **Direct Site Overhead Expenses:** The Contractor's per diem expenses, as shown by the itemized accounting, for the following allowable direct Site overhead expenses: The Site superintendent's pro-rata salary, temporary Site office trailer, and temporary Site utilities including basic telephone service, electricity, heat, water, and sanitary / toilet facilities for each Day added. All other direct expenses are covered by and included in the Subsection 38(d) markups above.

   b. **Home Office and Other Indirect Overhead Expenses:** A five percent (5%) markup on the above direct Site overhead expenses will be allowed as compensation for the Contractor's home office overhead and all other direct or indirect overhead expenses for Days added to the Time for Completion or the Contract Completion Date for a change in the Work. All other overhead and other direct or indirect overhead expenses are covered by and included in this markup and the Subsection (d) markups above.

   No direct Site, home office, or other indirect overhead shall be paid if the changed Work is done on a unit price basis unless the Contractor can demonstrate that the unit price does not include direct and indirect overhead costs.

7. Any other costs directly attributable to the change in the Work with the exception of those set forth in Subsection 38(f) below.

f. Allowable costs for changes in the Work shall not include the following:

   1. Costs due to the negligence of the Contractor, any Subcontractor, Supplier, their employees, or other persons for whom the Contractor is responsible**,** including, but not limited to, costs for the correction of Defective Work, for improper disposal of material, for equipment wrongly supplied, for delay in performing the Work, or for delay in obtaining materials or equipment.

   2. Home office expenses including payroll costs for the Contractor's officers, executives, administrators, accountants, counsel, timekeepers, clerks, and other similar administrative personnel employed by the Contractor, whether at the Site or in the Contractor's principal or branch office for general administration of the Work. These costs are deemed overhead included in the percentage markups allowable in Subsections 38(d) above.

   3. Home and field office expenses not itemized in Subsection 38(e) (6) above. Such items include, but are not limited to, expenses of Contractor's home and branch offices, Contractor's capital expenses, interest on Contractor's capital used for the Work, charges for delinquent payments, small tools, incidental job costs, rent, utilities, telephone and office equipment, and other general overhead expenses.

   4. Other items reasonably determined by the Owner to not be allowed.

g. All Change Orders, except initiating Change Orders authorizing work pursuant to Subsection 38(a)(3) procedures, must state that the Contract Completion Date is not changed or is either

increased or decreased by a specific number of Days. The old Time for Completion and, if changed, the new Time for Completion also must be stated.

If the Contractor requests an extension to the Contract Completion Date, it must provide written justification for the extension to the A/E and to the Owner. No extension to the Contract Completion Date shall be allowed unless, and then only to the extent that, the additional or changed Work increases the length of the Critical Path beyond the Contract Completion Date. Extensions to the Contract Completion Date will be granted only when an excusable delay exceeds the Total Float in the activity or path of activities affected by the Change Order. If approved, the increase in time required to complete the Work shall be added to the Contract Completion Date.

The Owner may decrease, by Change Order, the Contract Completion Date when an Ownerrequested deletion from the Work results in a decrease in the actual time required to achieve Substantial Completion of the Work. The Contractor may submit a request for an earlier Contract Completion Date under the procedures and subject to the considerations set forth in Section 19(f). No request for an earlier Contract Completion Date shall be considered for approval unless the proposed shorter schedule is otherwise acceptable under Sections 19(b) or (c), whichever is applicable.

With the exception of Change Orders under Subsection 38(a) (3), which shall arrive at a change to the Contract Price and Contract Completion Date using the procedures set forth therein, each Change Order shall include all time and monetary impacts of the change, whether the Change Order is considered alone or with all other changes during the course of the Project. Change Orders issued without a change to the Contract Completion Date and/or Contract Price conclusively establish that the change in the Work reflected by that Change Order had no impact on the Contract Price and/or Contract Completion Date. The parties may mutually agree in writing to postpone a determination of the time-related impacts of a change in the Work for a period of not more than forty-five (45) Days following completion of the change in the Work to give the Contractor an opportunity to submit documentation substantiating any requested change in the Contract Completion Date or Contract Price. During any such postponement, all Work shall proceed, unless the Owner agrees otherwise. The Contractor's failure to submit all required substantiating documentation during a forty-five (45) Day postponement shall conclusively establish that the change in the Work did not impact nor require an adjustment of the Contract Price and Contract Completion Date.

If at any time there is a delay in the Critical Path of the Work due to a postponement, the Contractor's efforts to justify an extension of the Contract Completion Date or an increase in the Contract Price, or the Contractor's refusal to proceed with any of the Work, such delay and any Contractor costs resulting from it shall not serve as the basis for the extension of the Contract Completion Date or for an increase in the Contract Price.

h. The acceptance by the Contractor of any payment made by the Owner under a Change Order shall be and operate as a release to the Owner of all demands and claims by the Contractor to additional compensation or an adjustment of the Contract Price or Contract Completion Date for all things done or furnished in connection with the Work described in the Change Order. The execution of any Change Order by the Owner shall not be an acceptance of any Work or materials not in accordance with the Contract Documents, nor shall it relieve the Contractor of responsibility for faulty materials, Defective Work or poor workmanship or operate to release the Contractor or its surety from any obligation arising under the Contract, the Standard Performance Bond, or the Standard Labor and Material Payment Bond.

i. Payments will not be made for any Work, labor, or materials performed on a unit price or a Subsection 38(a)(3) basis until the Contractor has furnished the Owner documents, certified as true and correct by an authorized officer or agent of the Contractor, evidencing the cost of such Work,

labor, and materials. The Owner may require any or all of the following documentation to be provided by the Contractor.

For Work performed on a Unit Price basis:

1. Certified measurements of authorized and approved excavations, over-excavations, fills and/or backfills, and similar work; and/or

2. Certified measurements of piling installed, caissons installed, and similar work; and/or

3. Daily records of waste materials removed from the Site and/or fill materials imported to the Site.

4. Other measurements as appropriate to establish the actual quantities of work being performed on a Unit Price basis.

For Work performed on a Subsection 38(a)(3) basis:

1. Certified payroll records showing the name, classification, date, daily hours, total hours, rate, and extension for each laborer, foreman, supervisor, or other worker;

2. Equipment type & model, dates, daily hours, total hours, rental rate, or other specified rate and extension for each unit of equipment;

3. Invoices for materials showing quantities, prices, and extensions;

4. Daily records of waste materials removed from the Site and/or fill materials imported to the Site;

5. Certified measurements of over-excavations, piling installed and similar work;

6. Transportation records for materials, including prices, loads, and extensions.

Requests for payment shall be accompanied and supported by invoices for all materials used and for all transportation charges claimed. If materials come from the Contractor's own stock, then an affidavit may be furnished, in lieu of invoices, certifying quantities, prices, etc. to support the actual cost.

39. EXTRAS

If the Contractor claims that any instructions given to him by the A/E or by the Owner, by drawings or otherwise, require extra work outside the scope of the Contract, then, except in emergencies endangering life or property, he shall give the A/E and the Owner written Notice thereof before proceeding to execute the extra work. Said Notice shall be given promptly enough to avoid delaying the Work and in no instance later than fourteen (14) Days after the receipt of such instructions. If it is not immediately clear to the Contractor that a request or instruction involves extra Work outside the scope of the Contract, then written Notice shall be sufficient if it's given as soon as possible after Contractor's realization that a request or instruction involves extra Work, but in no event later than fourteen (14) Days after the start of such extra Work. If the Owner agrees, a Change Order shall be issued as provided in Section 38 for the extra work and any additional compensation shall be determined by one of the methods provided in Subsection 38(a), as selected by the Owner. If the Owner does not agree, then the Contractor may submit a claim for the disputed cost or time as provided for in Section 47. No claim for additional compensation for extra work will be considered unless the Contractor timely has provided the required Notice.

40. CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE THE CONTRACT

If the Work should be stopped under an order of any court or other public authority for a period of ninety (90) Days through no fault of the Contractor or anyone employed by it, or if the Owner should fail to pay to the Contractor within thirty (30) Days any sum certified by the A/E when no dispute exists as to the sum due or any requirement of the Contract, then the Contractor may, upon ten (10) Days written Notice to the Owner and the A/E, stop Work or terminate the Contract and recover from the Owner payment for the cost of the Work actually performed, together with overhead and profit thereon, but profit on the Work performed shall be recovered only to the extent that the Contractor can demonstrate that it would have had profit on the entire Contract if it had completed the Work. The Contractor may not receive profit or any other type of compensation for parts of the Work not performed. The Contractor may recover the reasonable cost of physically closing down the Site, but no other costs of termination. The Owner may offset any claims it may have against the Contractor against the amounts due to the Contractor. In no event shall termination of the Contract by the Contractor terminate the obligations of the Contractor's surety on its payment and performance bonds.

41. OWNER'S RIGHT TO TERMINATE THE CONTRACT FOR CAUSE

a. If the Contractor should be adjudged as bankrupt, or if it should make a general assignment for the benefit of its creditors, or if a receiver should be appointed on account of its insolvency, the Owner may terminate the Contract. If the Contractor should refuse or should repeatedly fail, except in cases for which extension of time is provided, to supply enough properly skilled tradespeople or laborers or proper materials and equipment, or if it should fail to perform the Work in a diligent, efficient, workmanlike, skillful, or careful manner, or if it should fail or refuse to perform the Work in accordance with the Contract Documents, or if it should fail to make prompt payment to Subcontractors or Suppliers of material or labor, or if it should disregard laws, ordinances, building codes or the written instructions of the A/E or the Owner, or otherwise be in substantial, willful or repeated violation of any provision of the Contract, then the Owner may terminate the Contract.

b. Prior to termination of the Contract, the Owner shall give the Contractor and its surety ten (10) Days' Notice of such termination and allow ten (10) Days during which the Contractor and/or its surety may rectify the basis for the Notice. If rectified to the satisfaction of the Owner within said ten (10) Days, the Owner may rescind its notice of termination. If the basis for the termination is not rectified within said ten (10) Days, the termination for cause shall become effective at the end of the ten (10) Day period without further Notice to the Contractor. At any time, the Owner may, in writing, postpone the effective date of the termination for cause, at its sole discretion, if it should receive reassurances from the Contractor and/or its surety that the basis for the termination will be remedied in a time and manner which the Owner finds acceptable. If at any time after such a postponement, the Owner determines that Contractor and/or its surety has not or is not likely to rectify the causes of termination in an acceptable manner or to do so within the time allowed, then the Owner may immediately terminate the Contract for cause, without the necessity of further ten (10) Day Notice, by notifying the Contractor and its surety in writing of the termination. In no event shall termination for cause terminate the obligations of the Contractor's surety on its payment and performance bonds.

c. Upon termination of the Contract becoming effective, the Owner shall take possession of the Site and of all materials, tools and equipment thereon and shall proceed as follows:

1. **No Security or Bonds Provided:** If no security has been required pursuant to Section 8, the Owner shall finish the Work by whatever method the Owner deems reasonable or expedient. If the expense of finishing the Work, including compensation for additional managerial and administrative services, shall exceed the unpaid balance of the Contract

Price, the Contractor shall pay the difference to the Owner, together with any other expenses of terminating the Contract and having it completed by others.

2. **Security or Bonds Provided:** If security has been required and provided pursuant to Section 8 herein, the Owner shall provide Notice to the Surety that termination of the Contract became effective and proceed as set forth in the Standard Performance Bond (CO-10), and the Terms and Conditions therein. If the expense of finishing the Work, including compensation for additional managerial and administrative services, shall exceed the unpaid balance of the Contract Price and all amounts due under the Standard Performance Bond, the Contractor shall pay the difference to the Owner, together with any other expenses of terminating the Contract and having it completed by others.

d. If it should be judicially determined that the Owner improperly terminated this Contract for cause, then the termination shall be deemed to be a termination for the convenience of the Owner and the Contractor's rights and remedies shall be solely limited to those provided by Section 42 of these General Conditions.

e. Termination of the Contract for cause is in addition to and without prejudice to any other right or remedy of the Owner. Any actions by the Owner permitted herein shall not be deemed a waiver of any other right or remedy of the Owner under the Contract or under the law. The Owner may offset any claims it may have against the Contractor against the amounts due to the Contractor. The provisions of this Section shall survive termination of the Contract.

f. The provisions of Sections 3(j), 9(e), 14, 30 and 45 also shall survive termination of the Contract for cause.

42. TERMINATION BY OWNER FOR CONVENIENCE

a. The Owner may terminate this Contract, in whole or in part, at any time without cause upon giving the Contractor written Notice of such termination. Upon Notice of termination for convenience, the Contractor shall immediately cease Work and remove from the Site all of its labor forces, equipment and such of its materials as Owner elects not to purchase or to assume in the manner hereinafter provided. The Contractor also shall take such steps as Owner may require to assign to the Owner the Contractor's interest in all Subcontracts and purchase orders designated by Owner. After all such steps have been taken to Owner's satisfaction, the Contractor shall receive as full compensation the following:

1. Amounts due for Work performed in accordance with the Contract subsequent to the latest approved Schedule of Values and Certificate for Payment (CO-12) through the date of termination; and

2. All amounts due under Contract for Work completed prior to the date of termination; and

3. Reasonable compensation for the actual cost of demobilization incurred by the Contractor as a direct result of termination for convenience, plus overhead not to exceed 15 percent (15%) of the direct costs of demobilization.

The Contractor agrees it shall not be entitled to any additional compensation, including but not limited to loss of revenue, income, profit, business, reputation, or bonding capacity, consequential damages or lost profits, but shall only receive payment upon termination for convenience as stated in this Subsection 42(a). The Owner may offset any claims it may have against the Contractor against the amounts due to the Contractor. Upon payment of the amounts stated in this Subsection 42(a), Owner shall have no further obligations to Contractor of any nature.

b. In no event shall termination for the convenience of the Owner terminate the obligations of the Contractor's surety on the payment and performance bonds. The provisions of Sections 3(j), 9(e), 14, 30 and 45 also shall survive termination of the Contract for convenience.

c. Any actions by the Owner permitted herein shall not be deemed a waiver of any other right or remedy of the Owner under the Contract or under the law. The provisions of this Section shall survive termination of the Contract.

43. DAMAGES FOR DELAYS; EXTENSION OF TIME

a. **Excusable Non-Compensable Delays:** If the Critical Path is delayed by strikes, fires, unusual delays in transportation, unavoidable casualties, or other causes outside the control of the Owner and the Contractor, with the exception of delays caused by weather which are addressed in Section 6, and the Contractor seeks an extension of the Contract Completion Date, then the Contractor shall give the Owner and A/E written Notice of the delay not later than fourteen (14) Days following the inception of the delay. The Contractor shall give written Notice to the Owner and A/E of the termination of the delay event not later than fourteen (14) Days after the delay has ceased. Within twenty (20) Days after the delay event has ceased, Contractor shall submit to the Owner and the A/E, the Contractors' written request for an extension of the Contract Completion Date, specifically stating the cause of the delay, the number of days of extension requested, and an analysis of the delay event's impact on the Critical Path. If the Owner agrees that the Critical Path has been impacted by the delay event, the Owner shall extend the Contract Completion Date for the length of time that the Critical Path was delayed. The Contractor shall not be charged with liquidated or actual damages for such period of Critical Path delay nor shall the Contractor be due compensation or damages of any kind, under any theory of law, as a result of such Critical Path delay, the impact of such delay, or its acceleration of Work as a result of such delay.

b. **Excusable Compensable Delays:** If the Critical Path unreasonably is delayed by acts or omissions of the Owner, or its agents, contractors, or employees due to causes within the Owner's control, and the Contractor seeks an extension of the Contract Completion Date and/or additional compensation due to the unreasonable delay, then the Contractor shall notify the Owner and the A/E immediately at the time of the occurrence giving rise to the delay by the fastest means available. The Contractors also shall give written Notice to the Owner and A/E no later than two (2) business days after inception of the delay. The Contractor's written Notice shall specify the nature of the delay claimed by the Contractor, the cause of the delay, and the impact of the delay on the Critical Path. The Owner shall have three (3) business days to respond to the Contractor's Notice with a resolution, remedy, direction to alleviate the delay, or rejection of the Contractor's requested relief. The Owner's failure to respond within the time required shall be deemed to be a denial of the Contractor's entitlement to an extension of the Contract Completion Date and additional compensation. The Contractor shall also give written Notice to the Owner and A/E of the termination of the delay event not later than fourteen (14) Days after the delay has ceased. Within twenty (20) Days after the delay event has ceased, Contractor shall submit to the Owner and the A/E, the Contractor's written request for an extension of the Contract Completion Date, specifically stating the cause of the delay, the number of days of extension requested, a calculation of the additional compensation sought, and an analysis of the delay event's impact on the Critical Path. Requests for additional compensation must be substantiated by itemized data and records demonstrating that the costs incurred by the Contractor are directly attributable to the delay and shall be calculated from the Contract Completion Date, not using any early completion planned or scheduled by the Contractor unless a Change Order has been executed pursuant to Section 19(f) changing the Contract Completion Date to reflect such early completion. If and to the extent that a delay is caused by or due to the Owner or A/E taking any actions permitted or required by the Contract, the Contractor shall be entitled to an extension of the Contract Completion Date or additional compensation only for the portion of the delay that is unreasonable, if any.

c. **Non-Excusable Non-Compensable Delays:** The Contractor shall not be entitled to an extension of the Contract Completion Date or to any additional compensation if and to the extent a delay is: (1) caused by acts, omissions, fault, or negligence of the Contractor or its Subcontractors, agents or employees; (2) arises from foreseeable causes within the control of the Contractor or its Subcontractors, agents or employees, including, but not limited to, Defective Work, poor workmanship, improper or inferior materials, Defective Work which must be corrected before dependent work can proceed, Defective Work for which corrective action must be determined before like work can proceed, from incomplete, incorrect, or unacceptable Submittals or samples, or the failure to furnish enough or properly skilled workers, proper materials or necessary equipment to perform the work in a timely manner in accordance with the Project schedule; or (3) due to causes that would entitle the Owner to recover delay costs or other damages from Contractor.

d. No extension of time or additional compensation will be allowed unless the Contractor demonstrates that the delay directly impacted the Critical Path of the most current approved Project schedule and that all Float has been consumed. No extension of time or additional compensation will be allowed if the Contractor failed to provide all Notice and information in the manner and within the time periods set forth in Subsections 43(a) or (b) above, whichever applies. Failure to timely provide all required information and Notices shall preclude an extension of the Contract Completion Date or payment of additional compensation based upon that cause.

e. If the Contractor makes a claim against the Owner for costs or damages, the Contractor shall be liable to and shall pay to the Owner that percentage of all costs incurred by the Owner in investigating, analyzing, negotiating, and litigating or arbitrating that percentage of the claim which is determined through litigation or arbitration to be false or to have no basis in law or in fact. (*Code of Virginia*, § 2.2-4335).

f. Any change in the Time for Completion or Contract Completion Date shall be accomplished only by issuance of a Change Order.

g. **Agreed Compensation/Liquidated Damages for Contractor Delay:** If liquidated damages are not established in the Supplemental General Conditions, the Contractor shall be liable for any and all actual damages sustained by Owner as a result of a delay for which Contractor is responsible. In addition to damages for delay, whether liquidated or actual, the Contractor shall also be liable for any and all actual damages sustained by the Owner as a result of any other breach of the Contract, including, but not limited to, Defective Work or abandonment of the Contract.

44. INSPECTION FOR SUBSTANTIAL COMPLETION & FINAL COMPLETION

a. The Contractor shall advise the Owner using the Certificate of Partial or Substantial Completion by the Contractor (CO-13.2a) of the date when the Work or designated portion thereof will be substantially complete and ready for inspection and testing by Owner to determine if Substantial Completion has been achieved. Contractor shall deliver Form CO-13.2a to the A/E at least ten (10) Days in advance of the date identified on the Form CO-13.2a. The A/E shall then attach his or her written endorsement as to whether the Work will be ready for inspection and testing on the date identified on the Form CO-13.2a. The A/E's endorsement is a convenience to the Owner only and shall not relieve the Contractor of its responsibility nor shall the A/E's endorsement be deemed to evidence or establish that the Work was substantially complete or ready for inspection and testing. Inspection and testing shall take place at a time(s) mutually agreeable to the Contractor, Owner, A/E, and Building Official.

The inspection shall include a demonstration by the Contractor that all equipment, systems and operable components of the Project function properly and in accordance with the Contract

Documents. The Contractor shall furnish access for the inspection and testing as provided in Section 21 of these General Conditions. The inspection and testing shall determine whether Substantial Completion has been accomplished and shall result in a written list of unfinished Work and Defective Work, commonly referred to as a "punch list", which must be completed and corrected prior to Final Completion.

If, after successful completion of all testing, the Architect/ Engineer determines that the Work, either in whole or in part, has achieved Substantial Completion, the A/E shall notify the Owner of such, in writing, using the Certificate of Partial or Substantial Completion by the A/E (CO-13.1a).

The Owner shall notify the Contractor, in writing, of the date the Owner accepts the Work, or the specified portion thereof, as having achieved Substantial Completion or, if it is not, shall notify the Contractor of the deficiencies to be corrected or completed before such Work will be accepted as substantially complete.

b. The Contractor shall advise the Owner, in writing using the Certificate of Completion by the Contractor (CO-13.2) of the date when the Work has reached or will reach Final Completion and will be ready for final inspection and testing. Contractor shall deliver Form CO-13.2 to the A/E at least five (5) Days in advance of the date identified on the Form CO-13.2. The A/E shall then attach his or her written endorsement as to whether the Work will be ready for inspection and testing on the date identified on Form CO-13.2. The A/E's endorsement is a convenience to the Owner only and shall not relieve the Contractor of its responsibility nor shall the A/E's endorsement be deemed to evidence or establish that the Work achieved Final Completion. Final Completion inspection and any necessary testing shall be conducted in the same manner as the inspection for Substantial Completion. The Owner shall not establish the Final Completion Date until the Work is finally and totally complete, including the completion of punch list items, submission of all required documentation, and elimination and correction of all Defective Work.

c. Representatives of the Contractor, Owner, A/E, and Building Official will participate in the Substantial Completion and/or Final Completion inspections. The A/E shall conduct and document the inspections. The Owner may elect to have other persons of its choosing also participate in the inspections. If one or more Substantial or Final Completion re-inspections are required, the Contractor shall reimburse the Owner for all costs of re-inspection or, at the Owner's option, the costs may be deducted from payments due to the Contractor.

d. A representative of the State Fire Marshal's Office will either be present at the Substantial and Final Completion inspections or otherwise inspect the completed Work and report any fire safety deficiencies to the Building Official. The State Fire Marshal will advise the Owner and Contractor of those deficiencies.

e. Approval of Work at or as a result of any inspection required herein shall not release the Contractor or its surety from responsibility for complying with the Contract.

45. GUARANTEE OF WORK AND INDEMNIFICATION

a. Except as otherwise specified or required, the Contractor guarantees all Work, materials, equipment, and workmanship conform to the requirements of the Contract Documents and are free from defects, imperfections, or non-conformities, normal wear and tear excepted, for a period of one (1) year from the Final Completion Date. Equipment and facilities which have seasonal limitations on their operation (e.g. heating or air conditioning units) shall be guaranteed for one (1) full year from the date of the equipment's first seasonally appropriate test and acceptance, in writing, by the Owner. Where the Owner agrees to take Beneficial Occupancy of a portion or phase of the Work which has been determined to be substantially complete before the entire Work achieves Final Completion, the

guarantee for that portion or phase shall begin on the date that the Owner takes Beneficial Occupancy, unless otherwise specified in the Supplemental General Conditions, Special Conditions, or by separate agreement. This guarantee is separate and apart from any manufacturers' warranties and the warranty set forth in Section 30. At six (6) months and eleven (11) months after Substantial Completion, the Contractor shall meet with the Owner to review the status of and assign value to any unresolved warranty, guarantee, and punch list items.

b. If, within any guarantee period, Work which is not in accordance with the Contract, Defective Work, or inferior material, equipment or workmanship is noted by the Owner or A/E which requires or renders necessary repairs or changes in connection with the guaranteed Work, the Contractor shall, promptly upon receipt of Notice from the Owner, such Notice being given not later than two weeks after the guarantee period expires, and without expense to the Owner:

1. Correct, repair, replace or otherwise place in satisfactory condition all Defective Work, defects, nonconformity, inferior materials, equipment or workmanship;

2. Make good all damage to the structure or Site or equipment or contents thereof, which, in the opinion of the Owner or the A/E, is the result of the use of materials, equipment or workmanship which are inferior, defective or not in accordance with the requirements of the Contract; and

3. Make good any Work or materials or the equipment and contents of structures and/or Site disturbance that results from fulfilling the requirements of the guarantee.

c. In any case when in fulfilling the requirements of the Contract and this guarantee or any other guarantee or warranty the Contractor disturbs any work performed by a separate contractor, the Contractor shall restore such work to a condition satisfactory to the A/E and Owner and guarantee such restored work to the same extent as if it was guaranteed under this Contract.

d. If the Contractor, after Notice, fails to proceed promptly to comply with the obligations of this Section 45, and the surety, after Notice, fails to cure the Contractor's default as provided in Section 41, the Owner may undertake all needed corrections or repairs and the Contractor and its surety shall be liable for all expenses incurred.

e. All special warranties and guarantees applicable to definite parts of the Work that may be stipulated in or required by the Contract Documents shall be subject to the terms of this Section during the first year of such special warranty or guarantee. The guarantee of this Section shall be in addition to and not in lieu of all other warranties, express or implied, applicable to or arising from this Contract or by law.

f. Nothing contained in this Section shall be construed to establish a period of limitation with respect to any other obligation which the Contractor might have under the Contract Documents, including liability for Defective Work under Section 30, for indemnity or for breach of the Contract. This Section relates only to the specific obligation of the Contractor to correct the Work and does not limit the time within which its obligation to comply with the Contract Documents otherwise may be enforced, nor the time within which legal proceedings may be commenced to establish the Contractor's liability with respect to its obligations under the Contract Documents.

g. In the event the Work of the Contractor is to be modified by another contractor, either before or after the Final Inspection, the Contractor shall remain responsible in all respects under this Section's Guarantee of Work and under any other warranties or guarantees, express or implied, applicable to or arising from this Contract or by law. However, the Contractor shall not be responsible for any defects in material or workmanship introduced by another Contractor modifying Contractor's Work.

The Contractor and any contractor making modifications shall each be solely responsible for its respective work. A contractor modifying the Contractor's Work shall be responsible for any damage to or defect introduced into the Work by its modification.

If Contractor claims that a subsequent contractor has introduced defects of materials and/or workmanship into its Work, Contractor shall demonstrate clearly the nature and extent of such introduced defects and the other contractor's responsibility for those defects. Any contractor modifying the work of another shall have the same burden if it asserts that defects in its work were caused by the contractor whose work is modified.

h. The Contractor shall indemnify and hold harmless the Commonwealth of Virginia, the Owner and the Owner's consultants, representatives, agents and employees from and against any and all claims, causes of action, losses, costs, expenses or damages, including but not limited to attorney's fees, of any kind or nature whatsoever, arising from or relating to any bodily injury, including sickness, disease or death, any property damage, and any monetary loss, that results from or arises out of the Work performed by the Contractor, or by or in consequence of the Contractor's neglect in safeguarding the Work, its use of unacceptable materials in the Work, or resulting from any act, omission, negligence, or misconduct of the Contractor, any of its subcontractors, anyone directly or indirectly employed by them or anyone for whose acts the Contractor is or may be liable. The Owner may retain as much of the monies due the Contractor under the Contract as the Owner considers necessary to ensure that a fund will be available to pay a settlement or judgment of such suits, actions, or claims. If insufficient monies are or will become due, the Contractor's surety and/or insurers will not be released from liability until all such claims and actions have been settled and suitable evidence to that effect has been furnished the Owner.

46. ASSIGNMENTS

Neither party to the Contract shall assign the Contract in whole or any part without the written consent of the other, nor shall the Contractor assign any monies due or to become due to him hereunder, without the prior written consent of the Owner. Consent to assignment shall not be unreasonably withheld. No assignment shall relieve any party from its obligations under the Contract.

47. CONTRACTUAL DISPUTES (*Code of Virginia,* § 2.2-4363)

a. Contractual claims, whether for money or for other relief, shall be submitted, in writing, no later than sixty (60) Days after Final Payment; however, written Notice of the Contractor's intention to file such claim must be given to the Owner within fourteen (14) Days of the time of the occurrence or beginning of the Work upon which the claim is based. Such Notice shall state that it is a "notice of intent to file a claim" and include a written statement describing the act or omission of the Owner or its agents that allegedly caused or may cause damage to the Contractor and the nature of the claimed damage. Verbal notice, the Owner's actual knowledge, or a written notice given more than fourteen (14) Days after the occurrence or beginning of the Work upon which the claim is based, shall not be sufficient to satisfy the requirements of this Section. All claims shall state that they are "claims" pursuant to this Section, be submitted along with all practically available supporting evidence and documentation and the certification required by Subsection 47(f), and request a final decision. Certificates for payment, applications for payment, vouchers, invoices and similar requests for payment submitted for work done by the Contractor in accordance with the expected contract performance are routine submissions and are not claims under this Section. Proposed or requested Change Orders, demands for monetary compensation or other relief, and correspondence and e-mails to the Owner or its representatives, which do not strictly comply with the requirements of this Section, are not claims under this Section. Failure to timely provide notice of intent to submit

a claim shall preclude any relief to the Contractor, including but not limited to an extension of the Contract Completion Date or payment of additional compensation.

b. Although the Contractor may be required to submit certain classes of claims prior to Final Payment, and the Contractor is not prevented from submitting claims during the pendency of the Work, the Owner shall not be obligated to render a final written decision on any claim until after Final Payment. No written decision denying a claim or addressing issues related to the claim shall be considered a denial pursuant to this Section unless the written decision makes express reference to this Section and is signed by the Agency head or his or her designee. The Contractor may not institute legal action prior to receipt of the Owner's final written decision on the claim unless the Owner fails to render such a decision within ninety (90) Days of submission of the claim or within ninety (90) Days of Final Payment, whichever is later.

c. The decision of the Owner shall be final and conclusive unless the Contractor within six (6) months of the date of the final decision on a claim, initiates legal action as provided in *Code of Virginia* § 2.2-4364. Failure of the Owner to render a timely decision on a claim shall not result in the Contractor being awarded the relief claimed nor shall it result in any other relief or penalty. The sole result of the Owner's failure to render a timely decision shall be the Contractor's right to immediately institute legal action. No administrative appeals procedure pursuant to § 2.2-4365 of the *Code of Virginia* has been established for contractual claims under this Contract.

d. Pursuant to *Code of Virginia*, § 2.2-4366, Alternative Dispute Resolution, the Owner may enter into an agreement with the Contractor to submit disputes arising from the performance of this Contract to arbitration and utilize mediation and other alternative dispute resolution procedures. However, such procedures entered into by the Owner, the Commonwealth, or any department, institution, division, commission, board or bureau thereof, shall be non-binding and subject to *Code of Virginia* § 2.2-514, as applicable. The details for the implementation of Alternative Dispute Resolution are provided in CPSM Section 3.2.7.

e. In the event that a dispute, claim or controversy between the Owner and the Contractor arises regarding the requirements of the Contract, the performance of the Work, payment due the Contractor, the terms of any Change Order, or otherwise, the Contractor shall not stop, suspend or delay the Work or any part of the Work to be performed under the Contract, or under any Change Order, or as ordered by the Owner. The Contractor shall continue to diligently prosecute the Work to completion, including work required in any Change Order or as directed by the Owner.

f. The Contractor shall submit a Contractor's Claim Certification (DGS-30-234) certifying that the claim is a true and accurate representation of the claim. Claims submitted without the Contractor's Claim Certification will be deemed incomplete and will not be considered.

g. The compensation expressly provided for by this Contract shall be the Contractor's sole available compensation for the acts, omissions or breaches by the Owner. These remedies shall survive termination or breach of the Contract.

48. ASBESTOS

a. This subsection applies to projects involving existing buildings where asbestos abatement is not a part of the Work, when the scope of the Project has been reviewed and a comprehensive survey conducted by an individual licensed by the Virginia Department of Professional and Occupational Regulation to conduct building inspections for asbestos-containing materials in buildings, and where the Owner has attempted to remove or encapsulate all asbestos-containing material that may become friable or damaged during this Project.

Prior to commencement of Work, the results of the comprehensive survey or any other asbestos survey shall be made available to the Contractor, who shall be responsible for performing his Work so as not to disturb any remaining asbestos, encapsulated or otherwise, identified in such survey or surveys.

If the Contractor discovers or inadvertently disturbs any material that he knows, should have known or has reason to believe, may contain asbestos that has not been previously identified, was overlooked during the removal, was deemed not to be friable or was encapsulated, the Contractor shall stop Work in the area containing or suspected to contain the asbestos, secure the area, and notify the Owner and the A/E immediately by telephone or in-person with written Notice as soon as possible. The Owner will have the suspect material sampled.

If the sample is positive and must be disturbed in the course of the Work, the Owner shall have the material repaired or removed and shall pay for the bulk sample analysis.

Except as provided in *Code of Virginia* § 11-4.1, if the material disturbed is not within the Contractor's authorized Work and/or Work area or under this Contract, the Contractor shall pay for all associated sampling and abatement costs.

b. If asbestos abatement is included as a part of the Work, the Contractor shall assure that the asbestos abatement work is accomplished by those duly licensed as described in Section 3 of these General Conditions and in accordance with the specific requirements of the Contract and all applicable laws and regulations.

c. If asbestos abatement is included as part of the Work, the licensed asbestos Subcontractor shall obtain the insurance required under Section 11(b)(4) of these General Conditions.

49. TRAINING, OPERATION AND MAINTENANCE OF EQUIPMENT

a. As a part of the Work, the Contractor in conjunction with his Subcontractors and Suppliers shall provide the Owner's operations and maintenance personnel with adequate instruction and training in the proper operation and maintenance of any equipment, systems, and related controls provided or altered in the Work. The training requirements may be further defined in the Specifications.

b. The Contractor shall provide the Owner with a minimum of two (2) copies of operating, maintenance and parts manuals for all equipment and systems provided in the Work. Further specific requirements may be indicated in the Specifications.

50. PROJECT MEETINGS

a. The intention of this Section is that the Contractor, the Owner and the A/E have timely exchange of information and cooperate to accomplish the Work as required by the Contract Documents. The Contractor is responsible for managing the Work, obtaining approvals and requesting clarifications on a timely basis. The Owner and A/E are responsible for making a reasonable effort to provide timely responses to the Contractor.

b. **Preconstruction Meeting:** Prior to the start of construction and no later than 15 Days after the Notice to Proceed, a "Preconstruction" meeting shall be held with attendees to include the Owner's Project Manager and Project Inspector, the A/E's project manager and representatives of each design discipline involved in the Project, the Regional Fire Marshal, the Contractor's project manager and superintendent (and scheduler, if Contractor desires), and representatives of the Contractor's major Subcontractors. The purpose of the meeting is to clarify and discuss the specifics related to, but not limited to, the following:

1. Persons involved from each entity and their chain of authority including the names of persons authorized to sign Change Orders and any limits to their authority. Name of Contractor's on-site certified Responsible Land Disturber.

2. Names, addresses, email addresses, telephone numbers and FAX numbers to be used for Requests for Information (RFI), Requests for Clarification (RFC), Requests for Proposals (RFP), shop drawings, Submittals, and Notice.

3. Contractor's proposed construction schedule, the requirements for schedule updates and recovery schedules, assessment and management of risks to on-time and on-budget completion, and Owner's sequencing requirements, if any.

4. Schedule of Values and Certificate for Payment (CO-12) requirements and procedures.

5. Procedures for shop drawings, product data and Submittals.

6. Procedures for handling Field Orders and Change Order (CO-11).

7. Procedures for Contractor's request for time extension, if any.

8. Construction Site requirements, procedures and clarifications to include:
   - Manner of conducting the Work
   - Site specialties such as dust and erosion control, stormwater management, project signs, clean up and housekeeping, temporary facilities, utilities, security, and traffic
   - Safety
   - Layout of the Work
   - Quality control, testing, inspections, and notices required
   - Site visits by the A/E and others Owner's Project Inspector duties
   - Running Punch List
   - As-Built Drawings

9. Procedures and documentation of differing or unforeseen Site conditions.

10. Monthly Pay Meeting.

11. Assignment of responsibility for generation of meeting minutes of all project meetings.

12. Project Close-Out requirements and procedures.

13. Project records.

14. Requirements for the Contractor to furnish the Owner a list of hazardous materials that may be brought onto the job site, and 48- hour notification requirement.

c. **Monthly Pay Meeting:** Section 36 establishes the requirement for a monthly pay meeting which will usually be held at or near the Site. In addition to Owner, A/E and Contractor representatives, the following representatives, at a minimum, should be available to attend portions of the meeting, as applicable or necessary:
   - Owner's Project Inspector
   - Contractor's project superintendent

- A/E representative of each discipline where Work was performed for the current pay request or where Work is projected to be performed in the coming month.
- A representative of each subcontractor who performed work included in the current pay request.
- A representative of each subcontractor who is projected to perform work in the coming month.

The following topics should be included, as a minimum, in the monthly pay meeting:

1. Observations of status, quality and workmanship of Work in progress

2. Validation of the Schedule of Values and Certificate for payment

3. Status of progress of the Work and conformance with proposed construction schedule and recovery schedule, if any

4. Outstanding Requests for Information, Requests for Clarification and Requests for Proposal

5. Submittals with action pending

6. Status of pending Change Orders

7. Status of Running Punch List items

8. Work proposed for coming pay period

9. Discussions of any problems or potential problems which need attention

d. **Other Meetings:** Requirements for other meetings, such as progress meetings, coordination meetings, pre-installation meetings and/or partnering meetings, may be included in the Contract Documents.

51. SMALL BUSINESS PROCUREMENT PLAN

If the Total Contract Amount of the Contract is greater than $10,000 and the Contractor is a SWaM/SDV Business; then the Contractor shall include a Small Business Procurement Plan in its Bid (if subcontracting work is intended by the Contract as part of its performance of the Work).

If the Total Contract Amount of the Contract is greater than $100,000, then the Contractor shall include in its Bid a Small Business Procurement Plan and report on the involvement of SWaM/SDV Businesses in the Contractor's performance of the Contract as follows:

1. **Periodic Progress Reports**: The Contractor shall report on involvement of SWaM/SDV Business with each periodic invoice submitted by the Contractor. The report shall identify each subcontract or agreement with a SWaM/SDV Business, including the total contract value, and state the total amounts paid to each SWaM/SDV Business in connection with the Contract as of the report date. The report shall provide this information separately for each type of SWaM/SDV Business and shall clearly indicate those SWaM/SDV Businesses which were identified in the Contractor's Small Business Procurement Plan submitted by the Contractor in the procurement phase for the Contract. The Contractor shall provide two (2) copies of each periodic report to the Owner. Failure to submit the report with each invoice will result in the invoice being rejected by the Owner without payment.

2. **Final Compliance Report**: Prior to or with its final invoice for payment, the Contractor shall certify and report on its compliance with the Small Business Procurement Plan, submitted by the Contractor in its Bid for the Contract, to the Owner through DGS' eVA system. In the Final Compliance Report, the Contractor shall:

   - Provide a written explanation to the Owner of any variances between the Contractor's Small Business Procurement Plan and the actual participation of SWaM/SDV Businesses in the Contractor's performance of the Contract; and

   - Report on the involvement of other SWaM/SDV Businesses in the Contractor's performance of the Contract, including the contract value, the type of SWaM/SDV Business, a comparison of the actual amount paid with the planned amounts, the total amount paid to each type of SWaM/SDV Business, and a calculation of the percentage of the Total Contract Amount paid to SWaM/SDV Business.

   A format for the Final Compliance Report will be provided by the Owner.

The Owner may withhold final payment to the Contractor until the Contractor has complied with the requirements of its Small Business Procurement Plan submitted by the Contractor in the procurement phase for the Contract.

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Virginia Tech

Supplemental General Conditions to the General Conditions of the Construction Contract (Design-Bid-Build)

September 1, 2022

The Virginia Tech General Conditions of the Construction, Form HECO-7 (Version 1 dated 04/12/2021), are modified and supplemented as hereinafter described:

1. DEFINITIONS

Delete the definitions listed below and replace with the following:

Change Order: A document (Form CO-11) issued on or after the effective date of the Contract Between Owner and Contractor which is agreed to by the Contractor and approved by the Owner, and which authorizes an addition, deletion or revision in the Work, including any adjustment in the Contract Price and/or the Contract Completion Date. The term Change Order shall also include written orders to proceed issued pursuant to Section 38 (a) (3). A Change Order, once signed by all parties, is incorporated into and becomes a part of the Contract.

Contract: The Contract Between Owner and Contractor, hereinafter referred to as the Contract.

Contract Documents: The Contract between Owner and Contractor signed by the Owner and the Contractor and any documents expressly incorporated therein. Such incorporated documents customarily include the bid submitted by the Contractor, these General Conditions, any Supplemental General Conditions, any Special Conditions, the plans and the specifications, and all modifications, including addenda and subsequent Change Orders.

Insert the following definitions:

Limited Renovation: Renovations that do not involve structural work (including, but not limited to, foundations, supports, beams, exterior roof supports, load bearing walls, and roofing structures) and that do not involve Hot Work (as defined by the Virginia Statewide Fire Prevention Code) with the exception of brazing, soldering, and grinding.

Major Renovation: Renovations that do not meet the definition of Limited Renovation.

2. CONTRACT DOCUMENTS

(a) The Contract Between Owner and Contractor, the Workers' Compensation Certificate of Coverage (CO-9a), the Standard Performance Bond (CO-10), the Standard Labor and Material Payment Bond (CO-10.1), the Schedule of Values and Certificate for Payment (CO-12), the Affidavit of Payments of Claims (CO-13), the Contractor's Certificate of Substantial Completion (*HECO-13.2a), and the Contractor's Certificate of Completion (*HECO-13.2) issued by the Commonwealth of Virginia (* HECO-13.2a and HECO-13.2 are issued by the University Building Official) in its Construction and Professional Services Manual are forms incorporated in these General Conditions by reference and are made a part hereof to the same extent as though fully set forth herein. They must be used by the Contractor for their respective purposes.

3. LAWS AND REGULATIONS

(e) Building Permit: Because this Project is on university property, codes or zoning ordinances of local political subdivisions do not apply to Work on the property. The Virginia Uniform Statewide Building Code applies to the Work and is administered by the University Building Official for University owned Buildings. The Building Permit will be obtained and paid for by the Owner. All other permits, local license fees, business fees, taxes, or similar assessments imposed by the appropriate political subdivision shall be obtained and paid for by the Contractor. See Section 25 for utility connection fees and services.

11. CONSTRUCTION MANAGER'S AND SUBCONTRACTOR'S INSURANCE

Delete and replace Section 11.b and 11.c.1 with the following:

(b) Unless otherwise provided, the Contractor shall procure and maintain, as required herein, the following insurance coverages:

1. Workers' Compensation and Employer's Liability Insurance to cover all employees engaged in the Work of a type and in an amount to meet all Commonwealth of Virginia statutory requirements and regulations to provide all benefits to which employees may be entitled, with limits no less than $1,000,000 bodily injury by accident or disease, each employee. Where applicable, coverage shall be extended to cover any claims under the United States Longshoreman's Act and Harbor Workers Act and Jones Act as may be appropriate for the work.

2. Comprehensive General Liability insurance, including coverage for Broad Form Contractual, Premises/Operations, Product and Completed Operations, Independent Contractor's Liability, and Personal Injury Liability, with limits of at least $1,000,000 per occurrence and $2,000,000 aggregate, applicable on a per-project basis. The policy shall not exclude or limit the amount of coverage for the Work of the Project or for explosion, collapse, underground operations, mold, or exterior insulation and finish system ("EIFS").

3. Automobile Liability Insurance with a limit of not less than $1 million combined single limit for bodily injury and property damage per occurrence, covering all owned, non-owned, hired and borrowed vehicles, whether on-Site or off-Site.

4. Contractor or the Asbestos Subcontractor shall provide occurrence-based liability insurance with asbestos coverages in an amount not less than $1,000,000, and shall cover completed operations. The following shall be named as additional insureds on this policy: the Commonwealth of Virginia, its officers, employees and agents; the A/E (if not the Asbestos Project Designer); and the Contractor (where the asbestos work is being performed by the Asbestos Subcontractor).

5. Professional Liability, including design build errors and omissions and completed operations, with limits not less than $1,000,000 per occurrence or claim.

(c) Unless otherwise specified, Contractor shall ensure that all insurance required by Subsection (b) above contains the following provisions:

1. With the exception of Workers' Compensation and professional liability insurance, the Commonwealth of Virginia, the Owner, and their officers, employees and agents shall be named as additional insureds on all policies. The additional insureds as stated for the asbestos coverage shall be as stated in Section 11(b)(4).

REMAINING PORTION OF HECO-7 SECTION 11 IS APPLICABLE AND REMAINS UNCHANGED

12. "ALL-RISK" BUILDER'S RISK INSURANCE

Delete and replace Section 12.a, 12.b and 12.c with the following:

(a) Unless otherwise provided, the Contractor shall procure and maintain, at its cost, all-risk Builder's Risk insurance with minimum coverage and limits as follows:

1. New Construction, Addition, or Major Renovation: When the work is new construction, addition or major renovation, the Contractor shall maintain "all-risk" Builder's Risk insurance for the Work and the entire structure or structures, if any, on which the Work is to be done with a minimum limit of not less than the insurable value of the structure(s) plus one hundred percent (100%) of the Contract Price and the value of all Change Orders, to represent the total value of the structure(s) and the Work on a replacement cost basis.

2. Limited Renovation: When the work is limited renovation to an existing structure, the Contractor shall maintain "all risk" Builder's Risk insurance in an amount equal to one hundred percent (100%) of the Contract Price and the value of all Change Orders, to represent the total value of the Work on a replacement cost basis. The insurance must contain a Beneficial Occupancy Endorsement which enables Owner to occupy the facility during construction.

When the project is an addition with Limited Renovation to an existing structure, then the insurable value of the existing structure shall not be included.

(b) Builder's risk insurance shall be provided on an "all risk" or equivalent policy form and shall include, without limitation, insurance against all perils. The insurance shall cover the costs of debris removal, temporary buildings, legal requirements, and compensation for A/E services and Contractor services required following an insured loss. The insurance shall cover portions of the Work stored off-Site, Work in transit, and all materials, supplies, equipment, machinery, and fixtures that are or will be part of the Project. The policy shall include coverage for mold resulting from a covered peril, property in transit or temporary storage, equipment breakdown/course of construction, and soft costs within the aggregate or blanket limit of the of the policy. If not otherwise covered by the Builder's Risk policy, Contractor also shall provide an installation floater to cover all equipment and materials intended for installation at the Project.

In the event the policy includes any coverages where the limit is less than the aggregate or blanket limit of the policy (sub limits), the coverage shall be no less than the stated minimum sub-limits for the following perils:

- Flood	$2,000,000
- Earth Movement	$2,000,000
- Debris Removal	$1,000,000
- Extra or Expedited Expense	$2,000,000
- Interior Water Damage	$2,000,000
- Loss of Income/Extra Expenses	12 months
- Soft Costs	Blanket or Aggregate Limit/14-Day Waiting Period

The Certificate of Insurance provided to the Owner shall disclose all sub-limits, stating the peril and limit applying to each. In the event that the aggregate policy limit is less than the sub-limits identified above, coverage for all perils must be provided within the aggregate or blanket limit of the policy.

(c) Builder's risk insurance may include a deductible provision if the Owner so provides in the Supplemental General Conditions, in which case the Contractor will be liable for such deductible whenever a claim arises. Any loss payable under the Builder's Risk insurance shall be payable to the Owner, in accordance with its interests, as they may appear, and then to any other persons insured thereunder.

Written evidence of this insurance and a copy of the policy shall be provided to the Owner no later than thirty (30) Days following the award of the Contract. The policy shall not be canceled, dropped, replaced, or materially changed without at least thirty (30) Days' prior written Notice to and consent of the Owner.

13. TAXES, FEES AND ASSESSMENTS

The Contractor shall, without additional expense to the Owner, pay all applicable federal, state, and local taxes, fees and assessments except the taxes, fees and assessments on the real property comprising the Site of the project. If the University Building Official elects to have the local building official inspect the Work as provided by §36-98.1 of the Code of Virginia, the Owner shall pay the resulting fees to the local building official.

17. SUPERINTENDENCE BY CONTRACTOR

(a) The Contractor shall have a competent Superintendent, satisfactory to the Architect/Engineer and the Owner, on the Site at all times during the progress of the Work. The Superintendent shall be familiar with and be able to read and understand the plans and specifications, and be capable of communicating orally and in writing with the Owner's inspectors and the Contractor's workers. The Contractor shall be responsible for all construction means, methods, techniques, sequences and procedures, for coordinating all portions of the Work under the Contract except where otherwise specified in the Contract Documents, and for all safety and worker health programs and practices. The Contractor shall notify the Owner, in writing, of any proposed change in Superintendent, including the reason therefore, prior to making such change. Said notice shall be provided within forty-eight (48) hours of Contractor's knowledge regarding such change in Superintendent.

(b) The Contractor shall, at all times, enforce strict discipline and good order among the workers on the Project, and shall not employ on the Work, or contract with, any unfit person, anyone not skilled in the Work assigned to him, or anyone who will not work in harmony with those employed by the Contractor, the Subcontractors, the Owner or the Owner's separate contractors and their subcontractors.

(c) The Owner may, in writing, require the Contractor to remove from the Site any employee or Subcontractor's employee the Owner deems to be incompetent, careless, not working in harmony with others on the Site, or otherwise objectionable, but the Owner shall have no obligation to do so.

19. SCHEDULE

(a) The CPM schedule shall be developed using Primavera P6 software or other software as approved by the Owner.

36. PAYMENTS TO CONTRACTOR

(a) Unless otherwise provided in the Contract, the Owner will make partial payments to the Contractor on the basis of a duly certified and approved Schedule of Values and Certificate for Payment, Form CO-12, showing the estimate of the Work performed during the preceding calendar month or work period, as recommended by the Architect/Engineer. When evaluating the Contractor's Form CO-12, the

Architect/Engineer will consider the value of the Work in place, the value of approved and properly stored materials, the status of the Work on the critical path with regard to the Time for Completion, and the estimated value of the Work necessary to achieve Final Completion. To expedite the payment process, the Contractor is encouraged to submit a draft copy of his monthly pay application to the A/E and Owner for preliminary review prior to formally submitting the pay application in GC Pay. Once the draft copy is reviewed and returned, the Contractor shall submit the pay application to GC Pay after making any modifications to the estimates of work as noted by the A/E and/or Owner during their preliminary review. The submission date to GC Pay shall become the official receipt date of the pay application. The A/E and Owner shall then conduct a final review of the pay application in GC Pay and, if further modifications are deemed to be necessary, the Contract shall make such modifications to the document and resubmit the pay application in GC Pay. The official receipt date shall then be reestablished as the date on which an approved pay application was submitted by the Contractor to GC Pay. In preparing estimates, the material delivered to the Site and preparatory Work done shall be taken into consideration, if properly documented as required by Section 20 of these General Conditions, or as may be required by the Architect/Engineer so that quantities may be verified. In addition to material delivered to the Site, material such as large pieces of equipment and items purchased specifically for the Project, but stored off the Site within the Commonwealth of Virginia, may be considered for payment, provided all of the following are accomplished prior to the submission of the monthly payment request in which payment for such materials is requested:

REMAINING PORTION OF FORM DGS-30-054 (CO-7) SECTION 36(a) IS APPLICABLE AND REMAINS UNCHANGED

(h) Unless there is a dispute about the compensation due to the Contractor, Defective Work, quality of the Work, compliance with the Contract Documents, completion itself, claims by the Owner, other matters in contention between the parties, or unless monies are withheld pursuant to the Comptroller's Debt Setoff Program, within thirty (30) days after the official receipt date of the pay application as defined in Paragraph (a) above, the Owner shall pay to the Contractor the amount approved by the Architect/Engineer, less all prior payments and advances whatsoever to or for the account of the Contractor. In the case of Final Payment, the completed Affidavit of payment of Claims (Form CO-13), the Certificate of Completion by the Contractor (Form HECO-13.2) and the Certificate of Completion by the Architect/Engineer (Form HECO-13.1) shall accompany the final Schedule of Values and Certificate for Payment (CO-12) which is forwarded to the Owner for payment. The date on which payment is due shall be referred to as the Payment Date. In the event of disputes, payment shall be mailed on or before the Payment Date for amounts and Work not in dispute, subject to any set offs claimed by the Owner; provided, however in instances where further appropriations are required by the General Assembly or where the issuance of further bonds is required, in which case, payment shall be made within thirty (30) days after the effective date of such appropriation or within thirty (30) days after the receipt of bond proceeds by the Owner. All prior estimates and payments including those relating

to extra Work may be corrected and adjusted in any payment and shall be corrected and adjusted in the Final Payment. In the event that any formal pay application (CO-12) by the Contractor to GC Pay contains a defect or impropriety, the Owner shall reject the pay application in GC Pay and notify the Contractor of any defect or impropriety which would prevent payment by the Payment Date, within ten (10) days after the official receipt date.

38. CHANGES IN THE WORK

(a) Overhead and profit shall be equally and consistently applied to both additive and deductive changes in the Work (other than changes covered by unit prices) and shall be paid by applying the specified percentage markups only on the net cost of the changed Work (i.e. difference in cost between original and changed Work excluding overhead and profit). Said percentages for overhead and profit shall reasonably approximate the Contractor's overhead and profit, but shall not exceed the percentages for each category listed below:

(1) If a Subcontractor does all or part of the changed Work, the Subcontractor's markup for overhead and profit on the Work it performs shall be a maximum of fifteen percent (15%). The Contractor's mark-up for overhead and profit on the Subcontractor's price shall be a maximum of ten percent (10%).

(2) If the Contractor does all or part of the changed Work, its markup for overhead and profit on the changed Work it performs shall be a maximum of fifteen percent (15%).

(3) If a Sub-subcontractor at any tier does all or part of the changed Work, the Sub-subcontractor's markup on that Work shall be a maximum of fifteen percent (15%). The markup for overhead and profit on a sub-subcontractor's Work by the Contractor and all intervening tiers of Subcontractors shall not exceed a total of ten percent (10%).

(4) Where Work is deleted from the Contract prior to commencement of that Work without substitution of other similar Work, one hundred percent (100%) of the Contract Price attributable to that Work shall be deducted from the Contract Price. However, in the event that material Submittals have been approved and orders placed for said materials, a lesser amount, but in no case less than eighty percent (80%) of the Contract Price attributable to that Work, shall be deducted from the Contract Price. The credit to the Owner for reduced premiums on labor and material bonds and performance bonds shall in all cases be one hundred percent (100%).

52. AUDIT OF CONTRACTOR RECORDS

The Contractor, Subcontractors, and Suppliers agree to retain all financial and non-financial books, records, electronic files and other documents relative to this project for a minimum of five (5) years after final payment. Virginia Tech, the Commonwealth of Virginia, and their

authorized agents shall have full access and the right to examine any of said materials at any time during the performance of this contract and the 5 year period following final payment.

VIRGINIA TECH SPECIAL TERMS AND CONDITIONS:
9/8/2023

1) **PERFORMANCE STANDARDS:** All work is to be performed in compliance with the most current versions of the Virginia Tech Construction and Professional Services Manual ("CPSM") and the Virginia Tech Design and Construction Standards Manual ("DCSM").

2) **ELECTRONIC TRANSACTIONS AND EXECUTION IN COUNTERPARTS:** To the fullest extent permitted by Code of Virginia, Title 59.1, Chapter 42.1, the parties agree that electronic records, signatures, systems, formats, transmissions and communications (collectively, Electronic Transactions) may be utilized for this Project and this Agreement and all related documents, records, submissions, approvals, and communications (Ancillary Agreements). The parties agree that electronic signatures are the same as handwritten signatures for the purposes of validity, enforceability, and admissibility. The parties further agree that Electronic Transactions may be relied on for the purposes of binding information transfer for this Project. Unless otherwise agreed to in writing by the parties, the following shall be deemed an acceptable electronic signature for the purposes of this subsection: an electronic symbol or process attached to or logically associated with a record and executed or adopted by a person with the intent to sign the record. In the event the laws, rules, or regulations of a third party governmental agency or entity do not permit the use of Electronic Transactions or Electronic Signatures, then this section shall not apply but only to the extent necessary to comply with the laws, rules, or regulations of the third party governmental agency or entity.

   This Agreement, and any Ancillary Agreements, may be executed in one or more counterparts, each of which shall be deemed an original and all of which, when taken together, shall be deemed to be one and the same agreement. A signed copy of this Agreement, or any Ancillary Agreement, transmitted by any means of electronic transmission shall be deemed to have the same legal effect as delivery of an original executed copy of this Agreement or such Ancillary Agreement.

   RIGHTS AND REMEDIES: Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

3) **SECTION 179D: ALLOCATION OF ENERGY EFFICIENT DESIGN TAX DEDUCTION - Applicable to all A/E Design RFPs/Contracts and all Design-Build RFPs/Contracts:** Virginia Tech prioritizes environmental responsibility and sustainability in planning, development and construction of our facilities on Virginia Tech's campuses. These efforts, may be eligible for tax benefits under Section 179D of the Federal Tax Code, which allows a deduction based on the cost of certain qualifying, energy efficient property. Virginia Tech, in most cases, is unable to benefit directly from these deductions, however, Virginia Tech is permitted to allocate the deduction to parties responsible for the design of the qualifying property. Virginia Tech shall be reimbursed, by the applicant, for all costs incurred by Virginia Tech and its consultants to administer and support the application process.

   An individual or entity who is contracted directly with Virginia Tech to design certain energy efficient buildings may apply to Virginia Tech for an allocation of Section 179D Deductions.

Refer to the link below for IRS guidelines and applicable updates regarding project eligibility, https://www.gpo.gov/fdsys/pkg/USCODE-2010-title26/pdf/USCODE-2010-title26-subtitleA-chap1-subchapB-partVI-sec179D.pdf

4) **UNIVERSAL DESIGN PRINCIPLES:** Universal Design principles, as identified in Virginia Tech's Design Team Assistance Checklist, shall be embraced in all aspects of the design. The A/E shall explore opportunities to apply Universal Design principles in the design and composition of project elements to allow for ease of access, use, and understanding, to the greatest extent possible, by all people regardless of their age, size, ability, or disability. Submittals should demonstrate a thorough understanding of Universal Design principles and strategies to incorporate these principles into the built environment. The A/E will be required to document related efforts at each stage of the design process by completing and submit the Universal Design A/E Guidance Checklist (attached hereto as **Exhibit 1)** to the Virginia Tech Project Manager.

5) **ALL-GENDER BATHROOMS:** All-gender restrooms shall be included in each new capital project and major renovations at Virginia Tech. Whenever possible, every floor shall have an All-gender restroom that complies with the 2010 ADA Standards for Accessible Design and is accessible to the general public. The All-gender restroom shall be located nearby the men's and women's multi-user restrooms whenever possible. Appropriate signage shall be displayed for the restroom as well as directional signage if it is not feasible for the restroom to be located near the main floor restrooms. Each All-gender restroom shall be designed as a single occupancy restroom with appropriate locking and closer mechanisms for the operation of the fully accessible door. The toilet, lavatory and all required accessories shall be compliant with the 2010 ADA Standards for Accessible Design.

6) **VEHICULAR ACCESS AND PARKING AREAS:** In addition to the Vehicular Access and Parking Area requirements listed in the most recent version of the Virginia Tech Design and Construction Standards, include the following:

   a. **SIDEWALK PARKING**: Driving on sidewalks is allowed when there is no other way to get a needed vehicle to a designated place or building on campus. The vehicle operator shall be made aware that extreme caution shall be used to operate the vehicle in a way that will not be a hazard or hindrance to pedestrians using the walk. The Contractor shall be responsible for any damage to turf and anything that is located adjacent to the walk. Parking an unattended vehicle on a sidewalk is strictly prohibited by State Law. The Contractor is allowed to park a vehicle on a sidewalk if there is no other way to perform necessary work. The procedure to obtain a permit to operate a vehicle on sidewalks is the same as for the turf as outlined in Turf Policy. Any vehicle parked illegally on sidewalks shall be subject to ticketing, fines and towing if necessary.

   b. **TURF PARKING:** Parking or driving on campus turf or sidewalk is strictly prohibited, except as specifically directed or otherwise allowed by the Physical Plant Grounds Department. In this case, a turf permit must be obtained from Virginia Tech Parking Services and displayed by the vehicle. Turf parking is not allowed under the canopy of any tree on campus. Any vehicle parked illegally on turf or sidewalks shall be subject to ticketing and fines.

7) **COMMONWEALTH OF VIRGINIA TRAVEL REGULATIONS:** The Commonwealth of Virginia Travel Regulations can be downloaded from the Commonwealth's Website at:

https://www.doa.virginia.gov/reference/CAPP/CAPP_Topics_Cardinal/20335-2015-Dec.pdf

8) **SCHEDULING SOFTWARE:** When required to develop a CPM schedule, the Contractor shall use Primavera P6 or a similar system as approved in writing by Virginia Tech. Electronic parent files (i.e. XER for Primavera) shall be provided to Virginia Tech upon request. Microsoft Project shall not be used for developing a CPM schedule.

9) **CONTRACTOR CHANGE ORDER EVALUATION BY PROJECT A/E:** During the construction administration phase of the project, the A/E shall evaluate all Contractor Change Order requests to confirm the entitlement of the change as well as assess the reasonableness of the costs and schedule impacts.

10) **A/E QUALITY ASSURANCE OF DELIVERABLES:** The A/E shall Conduct Quality Assurance of all documents delivered to Virginia Tech per the QA checklist (**Appendix Q**) of the CPSM.

11) **CMAR FEE – Applicable to all CM at Risk RFPs and Contracts:** The CMAR fee shall include all costs and expenses for registration and monthly fees associated with eVA, and GC Pay.

12) **CMAR COST OF WORK ADJUSTMENT - Applicable to all CM at Risk RFPs and Contracts:** Any "savings" in the actual Cost of the Work versus the Cost of the Work included in the approved GMP shall revert to Virginia Tech and the GMP shall be reduced accordingly by Change Order. If the actual cost exceeds the amount of the approved GMP, those costs shall be borne by the CM.

13) **COVID Guidance to Vendors and Contractors:** All contracted service providers (including contractors and their subcontractors) of Virginia Tech who provide services on site at one of Virginia Tech's campuses or locations, university-owned or leased buildings, or active university construction sites must comply with the most recent COVID guidance and/or directives by Virginia Tech.

14) **WAGE THEFT and WORKER MISCLASSIFICATION –** Contractors and Subcontractors at any and all tiers shall ensure that wage theft and worker misclassification is prohibited.

15) **BUILDING INFORMATION MODEL ELECTRONIC FILES ACKNOWLEDGMENT:** At the request of Contractor, and approval of Virginia Tech, Contractor shall be provided, with electronic data/digital files ("Files") for the project. The Files shall be provided to Contractor in their native format as a convenience to Contractor for coordination of the work and preparation of Contractor's submittals such as shop drawings and coordination drawings. The Files referenced herein include any 3D models of the work. The Files will be shared by the AE with Contractor under the conditions of the Building Information Model Electronic Files Acknowledgement Agreement attached hereto as **Exhibit 2**.

EXHIBIT 1

Universal Design A/E Guidance Checklist

Principle 1: Equitable Use The design is useful and marketable to people with diverse abilities.		**A/E Narrative Response**
	Provide the same means of use for all users: identical whenever possible; equivalent when not.	
	Avoid segregating or stigmatizing any users.	
	Provisions for privacy, security, and safety should be equally available to all users.	
	Make the design appealing to all users	

Principle 2: Flexibility in Use The design accommodates a wide range of individual preferences and abilities.		**A/E Narrative Response**
	Accommodate right- or left-handed access and use.	
	Facilitate the user's accuracy and precision.	

Principle 3: Simple and Intuitive Use Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.		**A/E Narrative Response**
	Eliminate unnecessary complexity.	
	Be consistent with user expectations and intuition.	

Principle 4: Perceptible Information The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.		**A/E Narrative Response**
	Maximize "legibility" of essential information.	
	Differentiate elements in ways that can be described (i.e., make it easy to give instructions or directions).	
	Provide compatibility with a variety of techniques or devices used by people with sensory limitations.	

Principle 5: Tolerance for Error The design minimizes hazards and the adverse consequences of accidental or unintended actions.	A/E Narrative Response
Arrange elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded.	
Provide fail safe features.	

Principle 6: Low Physical Effort The design can be used efficiently and comfortably and with a minimum of fatigue.	A/E Narrative Response
Specify furnishings which allow user to maintain a neutral body position.	
Use reasonable operating forces.	
Minimize sustained physical effort.	

Principle 7: Size and Space for Approach and Use Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.	A/E Narrative Response
Provide a clear line of sight to important elements for any seated or standing user.	
Make reach to all components comfortable for any seated or standing user.	
Accommodate variations in hand and grip size.	
Provide adequate space and infrastructure for the use of assistive devices or personal assistance.	

EXHIBIT 2
TO THE VIRGINIA TECH SPECIAL TERMS AND CONDITIONS

Building Information Model Electronic Files Acknowledgement

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
BUILDING INFORMATION MODEL ELECTRONIC FILES ACKNOWLEDGEMENT

Owner:	Virginia Polytechnic Institute and State University ("Virginia Tech")
Architect/Engineer:	[***Insert A/E Name***] ("A/E")
Contractor:	[***Insert Contractor Name***] ("Contractor")
Project Name:	[***Insert Project Name***] ("Project")
Project Number:	[***Insert Project Number***]

This Building Information Model Electronic Files Acknowledgement ("Acknowledgement"), made effective this [***day***] day of [***month, year***], is to acknowledge and agree to the conditions of release by Owner (or A/E on Owner's behalf) of the building information model in electronic file format ("Model Files"), and the receipt and/or use of the Model Files, by Contractor, as a convenience and at its sole risk, for Contractor's coordination of the work and preparation of Project submittals, such as shop drawings and coordinated drawings.

Upon execution of this Acknowledgement, Virginia Tech authorizes A/E to provide Contractor with the Model Files for the Project. A/E shall provide the Model Files to Contractor in their native format.

The parties acknowledge and agree that:

1. A Building Information Model is a digital representation of the Project, or a portion of the Project, and is referred to in this Acknowledgment as a Model File, which may describe a model element, a single model or multiple models used in the aggregate. A model element is a portion of the Model Files representing a component, system or assembly.
2. The Model Files are Instruments of Service and are the exclusive and sole property of Virginia Tech including any copyright. Transmission of the Model Files conveys no ownership right in the Model Files;
3. The Model Files are not intended to be used for construction and are not Contract Documents under the terms of the A/E Contract or Contract for Construction;
4. The provision of the Model Files does not modify the terms of the respective contracts between Virginia Tech and the A/E or Virginia Tech and Contractor. Any use of, or reliance on, the Model Files by Contractor is at its own risk and without liability to Virginia Tech or the A/E. Acceptance, use, or reliance of the Model Files does not reduce nor modify Contractor's or A/E's contractual responsibilities for providing complete and coordinated services to Virginia Tech. Contractor further agrees to report any defects, deficiencies, errors or omissions, in the Model Files, discovered by Contractor or its subcontractors to A/E within ten (10) days of such discovery. It is understood and agreed that A/E will correct such defects, deficiencies, errors or omissions promptly and re-transmit the Model Files to Contractor.
5. Contractor shall be responsible for any costs of reviewing, updating or auditing of the Model Files and shall not request reimbursement from Virginia Tech resulting from Contractor's use of the Model Files;
6. Contractor shall ensure each subcontractor, supplier or vendor, which accesses or uses the Model Files for coordination and/or submittal preparation, acknowledges and agrees to all obligations and responsibilities which the Contractor, under this Acknowledgement, assumes toward Owner and A/E;
7. Such Model Files shall have all indices of A/E removed from the Model Files.
8. Contractor shall establish protocols for the usage and sharing of the Model Files with its subcontractors, suppliers and vendors and shall have the following ongoing responsibilities:
   a. Collecting incoming Model Files;

b. Coordinating submission and exchange of Model Files;
c. Reviewing Model Files for consistency in accordance with Section 4 of this Acknowledgement;
d. Maintaining a record copy of each Model File received from the A/E and any subsequent revisions by Contractor or its subcontractors, suppliers and/or vendors;
e. Properly maintaining Model Files archives and backups to ensure preservation of the Model Files;
f. Managing Model File access rights to ensure controlled and secure access; and
g. Submitting Model Files to Virginia Tech, as requested by Virginia Tech, or upon completion of the Work.

9. **Electronic Transactions**: If this paragraph is initialed by both parties, to the fullest extent permitted by Code of Virginia, Title 59.1, Chapter 42.1, the parties do hereby expressly authorize and consent to the use of electronic signatures as an additional method of signing and/or initialing this Acknowledgement and agree electronic signatures (for example, the delivery of a PDF copy of the signature of either party via facsimile or electronic mail or signing electronically by utilizing an electronic signature service) are the same as manual executed handwritten signatures for the purposes of validity, enforceability and admissibility.

_____ /_____
(Initials) (Initials)

ACKNOWLEDGED AND AGREED TO ON THE DATE INDICATED ABOVE BY:

_____	_____
A/E	**Contractor**
By: [***Type name here***]	By: [***Type name here***]
Title: [***Type job title here***]	Title: [***Type job title here***]
Date: _____	Date:_____

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VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
CONTRACT BETWEEN OWNER AND CONTRACTOR

This Contract, dated this ___ day of _____, 20__ between Virginia Polytechnic Institute and State University ("Owner," "Virginia Tech," "University") and _____ ("Contractor"), is binding among and between these parties as of the date of the Owner's signature.

RECITALS

1. The parties, their Project representatives, and contact information, including the places for delivery of Notice, are as follows:

Owner: Virginia Polytechnic Institute and State University

Attn: _____
Address: _____
City, State, Zip: _____
Telephone: _____
FAX: _____
Email Address: _____

Contractor:

Attn: _____
Address: _____
City, State, Zip: _____
Telephone: _____
FAX: _____
Email Address: _____
VA Contractor's License #: _____
FEIN/SSN: _____
Virginia SCC ID #: _____

Each party shall notify the other party promptly of a new Notice address. Unless and until Notice of the new address is given in the manner required for Notice, a Notice to such party is sufficient if given to the address set forth in Section 1.

2. The Project is identified as: _____

Project Title: _____

Project Code – PC#:_____

General Project Description: _____

The Project Code (PC#) indicated above shall be included on all Project-related material and documents including, but not limited to, Notices, Change Orders, Submittals, Requests For Information, Requests For Quotes, Field Orders, minutes of meetings, correspondence, Schedule of Values and Certificate For Payment (CO-12), and test reports.

3. After competitive sealed bidding pursuant to the Rules Governing Procurement of Goods, Services, Insurance and Construction by a Public Institution of Higher Education of the Commonwealth of Virginia, Contractor is awarded this Contract to perform the Work described by the Contract Documents for the Project.

THEREFORE, in consideration of the Recitals set forth above and which are part of the Contract and good and valuable consideration as set forth below, the parties agree as follows:

1. STATEMENT OF THE WORK

The Contractor shall furnish and provide all labor, equipment, and materials and perform all Work for the Project in strict accordance with the Contract Documents.

2. CONTRACT DOCUMENTS

a. The following documents are incorporated by reference into this Contract as if set forth fully herein:

1. **Attachment A -** the General Conditions of the Construction Contract (Virginia Tech HECO-7) dated April 12, 2021;
2. **Attachment B -** the Supplemental General Conditions dated September 1, 2022;
3. **Attachment C** - the Contractor's Bid form dated _____ in response to the Owner's Invitation for Bids;
4. **Attachment D** - the Virginia Tech Special Terms and Conditions dated September 8, 2023;
5. **Attachment E** - eVA Vendor Registration Requirements;
6. **Attachment F** - Post-Bid Modifications dated _____ (CO-9b);
7. **Attachment G** - Invitation to Bid including the Project Plans and Specifications dated _____ and related Addenda No. _____ through _____.

b. The Contract requires the Contractor to use the following standardized forms where applicable to the Work of this Project:

1. Standard Performance Bond (CO-10);
2. Standard Labor and Material Payment Bond (CO-10.1);
3. Workers' Compensation Certificate of Coverage (CO-9a);
4. Schedule of Values and Certificate for Payment (CO-12);
5. The Affidavit of Payments of Claims (CO-13);
6. The Contractor's Certificate of Substantial Completion (CO-13.2a);
7. Contractor's Certificate of Completion (CO-13.2).

c. All time limits stated in the Contract Documents, including but not limited to the Contract Completion Date and Time for Completion, are of the essence of the Contract.

d. The Contract shall be signed by the Owner and the Contractor in as many original counterparts as may be mutually agreed upon, each of which shall be considered an original.

e. Anything called for by one of the Contract Documents and not called for by the others, shall be of like effect as if required or called for by all, except that a provision clearly

designed to negate or alter a provision contained in one or more of the Contract Documents shall have the intended effect. Whenever possible, the Contract must be read as a whole with all parts being harmonized so as to avoid conflict. In the event that a dispute, claim or controversy between the Owner and the Contractor arises regarding the reqirements of the Contract, the performance of the Work, terms and conditions, or otherwise, the precedence of the Contract Documents shall be in the following order: 1) the Contract; 2) the Supplemental General Conditions; 3) the General Conditions; 4) the Special Conditions; 5) the Specifications; and 6) the Plans as specified in Paragraph 2.a. above.

f. If any provision of this Contract shall be held invalid by any court of competent jurisdiction, such holding shall not invalidate any other provision.

3. TIME FOR COMPLETION

The Work shall be commenced on a date to be specified in the Notice to Proceed from Owner. Contractor shall achieve Substantial Completion not later than the Contract Completion Date, which is _____. Contractor shall achieve Final Completion of the Work within _____ Days after the date of Substantial Completion of the Work.

4. STANDARD LABOR AND MATERIAL PAYMENT BOND AND STANDARD PERFORMANCE BOND

[Agency to select appropriate statement based upon the specific project.]

___ Contractor shall provide and maintain for the Project a Standard Labor and Material Payment Bond and a Standard Performance Bond meeting the requirements of the VPPA and Section 8 of the General Conditions.

___ Contractor does not need to provide a Standard Labor and Material Payment Bond or a Standard Performance Bond.

5. COMPENSATION TO BE PAID TO THE CONTRACTOR

The Owner agrees to pay and the Contractor agrees to accept as just and adequate compensation for the performance of the Work in accordance with the Contract Documents the sum of **_____ and 00/100 Dollars ($_____).**

6. PAYMENTS

The procedures for establishing a Schedule of Values for the Work, for requesting monthly progress payments for Work in place, and for requesting payments for properly stored materials are stated in the General Conditions. Unless otherwise provided under the Contract Documents, interest on payments due the Contractor shall accrue at the rate of one percent per month. *See* Code of Virginia § 2.2-4354.

eVA Vendor Registration: The Contractor shall be a registered vendor in eVA. *See* attached eVA Vendor Registration Requirements.

GCPay: Contract payments and SWaM reporting **shall be** made through GCPay.

7. AUTHORIZATION TO TRANSACT BUSINESS

The Contractor certifies that, if it is organized as a stock or nonstock corporation, limited liability company, business trust, or limited partnership or registered as a registered limited liability partnership, it is authorized to transact business in the Commonwealth of Virginia as a domestic or foreign business entity if so required by Title 13.1 or Title 50 of the Code of Virginia, or as otherwise required by law, and shall not allow its existence to lapse or its certificate of authority or registration to transact business in the Commonwealth of Virginia, if so required under Title 13.1 or Title 50, to be revoked or cancelled at any time during the term of the Contract. The Contractor understands and agrees that the Owner may void this Contract if the Contractor fails to comply with these provisions.

9. DEBARMENT AND ENJOINMENT

By signing this Contract, the undersigned on behalf of the Contractor, and the Contractor, certify that the Contractor, including any officer, director, partner or owner of the Contractor, is not currently barred from bidding on contracts by any Agency of the Commonwealth of Virginia, or any public body or agency of another state, or any agency of the federal government, nor is this Contractor a subsidiary or affiliate of any entity that is currently barred from bidding on contracts by any of the same.

10. ALL RISK BUILDER'S RISK INSURANCE

___ This Project is **New Construction, Addition, or Major Renovation**. Contractor shall procure and maintain "all-risk" Builder's Risk insurance as set forth in Section 12 of the General Conditions for New Construction, Addition, or Major Renovation.

___ This Project is **Limited Renovation.** Contractor shall procure and maintain "all risk" Builder's Risk insurance as set forth in Section 12 of the General Conditions for Limited Renovation.

11. ELECTRONIC TRANSACTIONS: If this paragraph is initialed by both parties, to the fullest extent permitted by Code of Virginia, Title 59.1, Chapter 42.1, the parties do hereby expressly authorize and consent to the use of electronic signatures as an additional method of signing and/or initialing this contract and agree electronic signatures (for example, the delivery of a PDF copy of the signature of either party via facsimile or electronic mail or signing electronically by utilizing an electronic signature service) are the same as manual executed handwritten signatures for the purposes of validity, enforceability and admissibility.

_____ / _____
(Initials) **(Initials)**

IN WITNESS WHEREOF, the parties have executed this Contract on the dates set forth beside their respective signatures.

For the CONTRACTOR:

By: _____
(signature in ink) *(date)*

_____
(typed name)

_____
(typed title)

Attest:

_____
(signature in ink) *(date)*

For the OWNER:

By: _____
(signature in ink) *(date)*

_____
(typed name)

_____
(typed title)

Attest:

_____
(signature in ink) *(date)*

Attachment A

General Conditions of the Construction Contract (Virginia Tech HECO-7) dated April 12, 2021

Attachment B
the Supplemental General Conditions dated September 1, 2022

Attachment C

the Contractor's Bid form dated _____ in response to the Owner's Invitation for Bids

Attachment D
the Virginia Tech Special Terms and Conditions dated September 8, 2023

Attachment E
eVA Vendor Registration Requirements

Attachment F

Post-Bid Modifications dated _____ (CO-9b)

Attachment G

Invitation to Bid including the Project Plans and Specifications dated _____ and related Addenda No. _ through _

COMMONWEALTH OF VIRGINIA
WORKERS' COMPENSATION
Certificate of Coverage

Section 2.2-4332, Code of Virginia, requires construction contractors and subcontractors to obtain and maintain workers' compensation insurance while performing work on behalf of the Commonwealth of Virginia, its departments, institutions, or agencies. This same requirement applies on behalf of local governments.

Evidence of coverage must be provided prior to commencement of Work.

This form must be completed and returned to the organization contracting the Work.

The undersigned organization stipulates that it:

A. has workers' compensation insurance and is in compliance with the Workers' Compensation statutes of the Commonwealth of Virginia. _____ Yes _____ No
Insurance Company _____
Policy expiration date _____

B. is self insured for workers' compensation. _____ Yes

Title of Construction Contract: _____

_____

Contract Number: _____

Signed by: _____

Title: _____

Firm Name: _____

Address: _____

_____

_____

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POST BID MODIFICATION

DATE:

PROJECT:
Location:
Project Code:

Reference: Contract Documents dated _____ including Addenda _____ and ____ as prepared by _____.

OWNER:

CONTRACTOR:

As allowed by Section 12 (c) of the Instructions to Bidders, Form DGS-30-055 (CO-7a), and by §2.2-4318, Code of Virginia, 1950 as amended, negotiations were conducted with the lowest responsive and responsible bidder, _____ , hereinafter called the Contractor. The following clarifications, amendments, deletions, revisions, substitutions, and/or modifications to the Contract Documents were made along with corresponding adjustments in the Contractor's bid amount for furnishing all labor and materials and performing all work necessary for construction of this project in accordance with the modified contract documents:

END OF POST BID MODIFICATION

Attach copy of this CO-9b to NOTICE OF AWARD and to the CONTRACT, (CO-9).

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COMMONWEALTH OF VIRGINIA
STANDARD PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: That _____, the Contractor ("Contractor" or "Principal") whose principal place of business is located at _____ and _____ ("Surety") whose address for delivery of 'Notices' is located at _____ are held and firmly bound unto the Commonwealth of Virginia, _____, the Owner ("Obligee") in the amount of _____ Dollars ($ _____) for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

Principal has by written agreement dated _____ entered into a contract with Obligee for _____ which contract (the "Contract") is by reference expressly made a part hereof;

NOW THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if the Principal shall promptly and faithfully perform said Contract in strict conformity with the plans, specifications and conditions of the Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

Provided, that any alterations which may be made in the terms of the Contract, or in the Work to be done under it, or the giving by the Obligee of any extension of time for the performance of the Contract, or any other alterations, extensions or forbearance on the part of either or both of the Obligee or the Principal to the other shall not in any way release the Principal and the Surety, or either of them, their heirs, executors, administrators, successors or assigns from their liability hereunder, notice to the Surety of any such alterations, extension, or forbearance being hereby waived.

No action shall be brought on this bond unless brought within five years after completion of the Contract. Completion of the Contract is established when the final payment is made to the Contractor pursuant to the terms of the Contract. However, if a final certificate of occupancy or written final acceptance of the Project is issued prior to final payment, the five-year period to bring an action shall commence no later than 12 months from the date of the certificate of occupancy or written final acceptance of the Project. The Surety represents to the Principal and to the Obligee that it is legally authorized to do business in the Commonwealth of Virginia.

Signed and sealed this _____ day of _____

_____
Contractor / Principal **(SEAL)**

_____ By:_____
Witness Typed Name: _____
Title: _____

_____
Surety **(SEAL)**

By:_____
Attorney-in-Fact
Typed Name: _____

AFFIDAVIT AND ACKNOWLEDGEMENT OF ATTORNEY-IN-FACT

COMMONWEALTH / STATE OF _____
CITY/COUNTY/TOWN of _____

I, the undersigned notary public, do certify that _____, whose name is signed to the foregoing performance bond in the sum of _____ and dated _____ and which names the Commonwealth of Virginia, _____, as Obligee, personally appeared before me today in the above jurisdiction and made oath that he/she is the attorney-in-fact of _____, a _____ corporation which is the Surety in the foregoing bond, that he/she is duly authorized to execute on the above Surety's behalf the foregoing bond pursuant to the Power of Attorney noted above and attached hereto, and on behalf of the surety, he/she acknowledged the foregoing bond before me as the above Surety's act and deed.

She/he has further certified that her/his Power of Attorney has not been revoked.
[Complete if Power is recorded: Clerk's Office: _____;
Deed Book/Page No. or Instrument No.: _____.]

Given under my hand this _____ day of _____.

_____
Notary Public (SEAL)

My name (printed) is: _____
My registration number is: _____
My commission expires: _____

APPROVED:

_____ _____
[Deputy] [Senior] Assistant Attorney General Date
Designee of the Attorney General
pursuant to delegation dated _____

Terms and Conditions of the Performance Bond

1 The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the prompt and faithful performance of the Contract, which is incorporated herein by reference.

2 If the Contractor promptly and faithfully performs the Contract in strict conformity with the plans, specifications and conditions of the Contract, the Surety and the Contractor shall have no obligations under this Bond.

3 In the event of the Contractor's Default, and subsequent notification to the Surety pursuant to Section 41 of the General Conditions of the Contract, the Surety shall, within fourteen (14) days of receipt of such notice, contact the Owner in writing, and arrange a meeting with the Owner to discuss methods of completing the Contract. See paragraph 4, below, for the options to be discussed. If the Surety fails to arrange a meeting or fails to attend such meeting, the Surety shall be deemed to be in default on this Bond and the Owner may, at its sole discretion, take what measures it deems necessary to protect the Owner's interests, without further notice to the Surety, and the Owner shall be entitled to enforce any remedy available to the Owner under the Contract or under Virginia law.

4 Within thirty (30) days after such meeting, during which time the Surety may investigate and otherwise analyze the project, and which period shall not toll any Contract time periods nor operate as a waiver of any of the Owner's rights, the Surety shall, at its own expense, notify the Owner in writing that it is taking one of the following actions, which shall be acceptable to the Owner, at the Owner's sole discretion:

4.1 By written takeover agreement with the Owner, the Surety itself shall undertake to perform and complete the Contract, which it may do through its licensed agents or through licensed independent contractors. If the Owner, at its sole discretion, consents, the Contractor may serve as the Surety's independent contractor (however, due to conflicts with the Virginia Public Procurement Act, the Owner may not directly contract with an otherwise qualified independent contractor produced by the Surety); or

4.2 The Surety may, if acceptable to the Owner and at the Owner's sole discretion, waive its right to perform and complete the Contract, and with reasonable promptness under the circumstances:

4.2.1 Pay to the Owner all amounts for which it may be liable to the Owner as surety on this Performance Bond, including the damages described in paragraph 6 below; or

4.2.2 Deny liability, in whole or in part, and provide written notice thereof to the Owner, citing reasons therefor.

5 If, after the meeting described in paragraph 4, above, the Surety does not proceed with reasonable promptness with one of the options provided in subparagraphs 4.1 or 4.2

(including its subparts), above, the Owner may send additional written notice to the Surety demanding that the Surety perform its obligations under the Bond. If the Surety does not proceed to perform its obligations under the Bond within fifteen (15) days after receipt of said notice, the Surety shall be deemed to be in default on this Bond. Thereafter, the Owner shall be entitled to enforce any remedy available to the Owner under the Bond, the Contract or Virginia law. If the Surety proceeds as provided in Subparagraph 4.2, and the Surety and the Owner are unable to agree as to the amount for which the Surety may be liable to the Owner, or if the Surety has denied liability, in whole or in part, the Owner, without further notice, shall be entitled to enforce any remedy available to the Owner under the Bond, the Contract or Virginia law. In such event, the Owner may immediately proceed to complete the work in any manner authorized by law.

6 After the Owner has terminated the Contractor's right to complete the Contract, and if the Surety elects to act under Subparagraph 4.1 or 4.2.1, above, then the responsibilities of the Surety to the Owner shall not be greater or less than those of the Contractor under the Contract, and the responsibilities of the Owner to the Surety shall not be greater than or less than those of the Owner under the Contract. To the limit of the amount of this Bond, plus the increased cost of any change orders under the Contract, provided the Owner commits the balance of the Contract Price to the prompt and faithful completion of the Contract, the Surety is obligated without duplication for:

6.1 The responsibilities of the Contractor for correction of defective work and completion of the Contract;

6.2 Additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 4; and

6.3 Liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non-performance of the Contractor.

The Owner, at its sole discretion, may waive its claim to delay costs and/or liquidated damages.

7 The Surety shall not be liable to the Owner for obligations of the Contractor that are unrelated to the Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner, its officers, agencies, administrators, successors or assigns.

8 The Surety hereby waives notice of any changes, including changes of time, to the Contract or to related subcontracts, purchase orders and other obligations. The Surety understands and agrees that the penal amount of the bond shall be increased or decreased by any changes to time and amount incorporated into any Change Orders.

9 Any proceeding by the Owner, legal or equitable, under this Bond may be instituted in any Virginia state court of competent jurisdiction, as permitted under Section 8 of the General

Conditions of the Contract and Virginia Code § 2.2-4337 and 2.2-4340, or by the Contractor or Surety, as permitted under the Contract or under Virginia law.

10 Notice to the Surety shall be mailed or delivered to the address shown on the Standard Performance Bond in the space for Surety address for delivery of Notices

11 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond when furnished to comply with statutory requirements.

12 DEFINITIONS

12.1 **Balance of the Contract Price**: The total amount payable by the Owner to the Contractor under the Contract after all proper adjustments have been made, reduced by all valid and proper payments made to or on behalf of the Contractor under the Contract.

12.2 **Contract**: The agreement between the Owner and the Contractor identified on first page of the Standard Performance Bond, DGS-30-084, CO-10, including all Contract Documents and duly executed modifications and change orders thereto.

12.3 **Contractor Default**: Failure of the Contractor, as defined under Section 41 of the General Conditions to the Contract, which has neither been remedied, as permitted under Section 41 at the Owner's sole discretion, nor expressly waived by the Owner, to perform or otherwise to comply with the terms of the Contract.

13 Nothing in these General Conditions shall prevent a surety from becoming involved in the Contract prior to termination, upon notice from the Owner of the Contractor's failure to promptly and faithfully perform the Contract in strict conformity with the plans, specifications and conditions of the Contract.

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COMMONWEALTH OF VIRGINIA
STANDARD LABOR AND MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: That _____, the Contractor ("Principal") whose principal place of business is located _____ and _____ ("Surety") whose address for delivery of 'Notices' is located at _____ are held and firmly bound unto the Commonwealth of Virginia, _____, the Owner ("Obligee") in the amount of _____ Dollars ($_____) for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

Principal has by written agreement dated _____ entered into a contract with Obligee for _____ which contract (the "Contract") is by reference expressly made a part hereof;

NOW THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if the Principal shall promptly make payment to all claimants as hereinafter defined, for labor performed and material furnished in the prosecution of the Work provided for in the Contract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions.

The Principal and Surety, jointly and severally, hereby agree with Obligee as follows:

1. A claimant is defined as one having a direct contract with the Principal or with a subcontractor of the Principal for labor, material, or both for use in the performance of the Contract. A "subcontractor" of the Principal, for the purposes of this bond only, includes not only those subcontractors having a direct contractual relationship with the Principal, but also any other contractor who undertakes to participate in the Work which the Principal is to perform under the aforesaid Contract, whether there are one or more intervening subcontractors contractually positioned between it and the Principal (for example, a subcontractor). "Labor" and "material" shall include, but not be limited to, public utility services and reasonable rentals of equipment, but only for periods when the equipment rented is actually used at the work site.

2. Any claimant who has a direct contractual relationship with the Principal and who has performed labor or furnished material in accordance with the Contract documents in furtherance of the Work provided in the Contract, who has not been paid in full therefor before the expiration of ninety (90) days after the day on which such claimant performed the last of such labor or furnished the last of such materials for which he claims payment, may bring an action on this bond to recover any amount due him for such labor or material, and may prosecute such action to final judgment and have execution on the judgment. The Obligee need not be a party to such action and shall not be liable for the payment of any costs, fees or expenses of any such suit.

3. Any claimant who has a direct contractual relationship with any subcontractor of the Principal but who has no contractual relationship, express or implied, with the Principal, may bring an action on this bond only if he has given written notice to the Principal within ninety (90) days from the day on which the claimant performed the last of the labor or furnished the last of the materials for which he claims payment, stating with substantial accuracy the amount claimed and the name of the person for whom the Work was performed or to whom the material was furnished. Notice to the Principal shall be served by registered or certified mail, postage prepaid, in an envelope addressed to the Principal at any place where his office is regularly

maintained for the transaction of business. Claims for sums withheld as retainages with respect to labor performed or materials furnished shall not be subject to the time limitations stated in this paragraph 3.

4. No suit or action shall be commenced hereunder by any claimant.

   a. Unless brought within one year after the day on which the person bringing such action last performed labor or last furnished or supplied materials, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof, the limitation embodied within this bond shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

   b. Other than in a Virginia court of competent jurisdiction, with venue as provided by statute, or in the United States District Court for the district in which the project, or any part thereof is situated.

5. The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder.

Signed and sealed this _____ day of _____

_____
Contractor / Principal **(SEAL)**

_____ By: _____
Witness Typed Name: _____
Title: _____

_____
Surety **(SEAL)**

By: _____
Attorney-in-Fact
Typed Name: _____

AFFIDAVIT AND ACKNOWLEDGEMENT OF ATTORNEY-IN-FACT

COMMONWEALTH / STATE OF _____
CITY/COUNTY/TOWN of _____

I, the undersigned notary public, do certify that _____, whose name is signed to the foregoing labor and material payment bond in the sum of _____ and dated _____ and which names the Commonwealth of Virginia, _____, as Obligee, personally appeared before me today in the above jurisdiction and made oath that he/she is the attorney-in-fact of _____, a _____ corporation which is the Surety in the foregoing bond, that he/she is duly authorized to execute on the above Surety's behalf the foregoing bond pursuant to the Power of Attorney noted above and attached hereto, and on behalf of the surety, he/she acknowledged the foregoing bond before me as the above Surety's act and deed

She/he has further certified that her/his Power of Attorney has not been revoked.
[Complete if Power is recorded: Clerk's Office: _____;
Deed Book/Page No. or Instrument No.: _____.]

Given under my hand this _____ day of _____.

_____
Notary Public (SEAL)

My name (printed) is: _____
My registration number is: _____
My commission expires: _____

APPROVED:

_____ _____
[Deputy] [Senior] Assistant Attorney General Date
Designee of the Attorney General
pursuant to delegation dated _____

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Construction Contract Change Order Navigation Pane

Read instructions for completing each part of the change order.	**Instructions**
Start with this tab and enter project information and change order log info.	**CO Log**
List Construction Change Orders (Summary of Work)	**CO-11 Part 1**
List Construction Change Orders (Itemization of Work)	**CO-11 Part 2**
Enter Change Order Justification (A/E's Justification)	**CO-11a Part 1**
Enter Change Order Justification (Agency's Justification)	**CO-11a Part 2**
Refer to this tab for Change Order Justification Reason Codes.	**CO-11a Part 3**
Complete all sections including submittal requirements and description.	**Transmittal**

Go to Navigation Sheet

INSTRUCTIONS FOR COMPLETING THE CO-11 and CO-11a FORMS

I. GENERAL INSTRUCTIONS

Please read all instructions carefully before using this spreadsheet to create the CO-11 and CO-11a forms.

Macros must be "enabled" to use this template.
In order for macros to run in Excel, the Excel macro security setting must be set to "Medium". To adjust this setting, go to Tools / Macro / Security on the Excel menubar and adjust security setting to "Medium". You may need to exit Excel once and then re-open Excel for the new security setting to take effect.

Excel/Office 2007 users may need to save this as a "Macro-Enabled Worksheet".

This spreadsheet contains a number of built-in calculations to simplify the creation of CO-11 and CO-11a forms. To ensure the integrity of the data, please do not attempt to modify the spreadsheet. Areas where data can be entered are highlighted in yellow.

It is recommended that the user print a copy of this instruction sheet to use as a reference when completing these forms.

The various Parts of the CO-11 and CO-11a are accessed by clicking on the blue tabs at the bottom of the screen.

Use the tab key to move forward to the next fillable field. |----->

Use the shift-tab to move backwards to the previous fillable field. <-----|

(You can also use the mouse and cursor keys to navigate, but the tab key is generally the most efficient means.)

Some fields have "drop-down" selection arrows on the right side of the field. For these types of fields, click on the arrow, then select an appropriate choice from the list.

Click on the tabs at the bottom of this file to go to the appropriate page.

THE TRANSMITTAL

The Change Order Transmittal for DEB Review Services is a required part of the submittal for review of a change order. See other submittal requirements on the Change Order Transmittal for change order review.

THE CHANGE ORDER LOG ("CO Log" tab)

The most important part of this spreadsheet is the "Contract Summary and Change Order Log".

The "Contract Summary" contains general project information, a running tally of all approved change orders, and the original and current contract costs and completion dates.

The "Change Order Log" lists the key cost and schedule data for each change order and also identifies if approval by the Governor's Designee is required.

The information entered in the Contract Summary and Change Order Log is used to automatically complete portions of the CO-11 and CO-11a forms for the Change Order number entered on the "CO-11 Part 1" sheet.
Specifically, the general information from the Contract Summary and Change Order Log is used to automatically complete:

- CO-11, Part 1 (Fully completes Part 1.)
- CO-11, Part 2 (Completes the header information. Remaining portions must be completed by user.)
- CO-11a, All Parts (Completes the header information. Remaining portions must be completed by user.)

This built-in automation was designed to save users from redundant keying of data and to eliminate math and transposition errors.

When entering data in the Change Order Log, always enter the change orders sequentially, starting with the lowest number change order.
(Do not leave a blank line between change orders or erroneous totals may result !)

Always update the Contract Summary and Change Order Log first, before completing and generating the CO-11 and CO-11a.

IF YOU WISH TO RETAIN DETAILED INFORMATION FOR EACH CHANGE ORDER, DO THE FOLLOWING:

Before beginning each new CO-11, make a copy of the spreadsheet. (Do a "Save as" and name the new version of the spreadsheet: "Change Order Number XX", substituting for "XX" the number of the next Change Order to be created.)
While the Change Order Log will list summary information for all Change Orders to date, only the detailed information (i.e., the CO-11 and CO-11a) for one change order number is saved in the spreadsheet. (The spreadsheet is not meant to be a repository of all CO-11 and CO-11a forms. It is intended to be used to create, save, and print information for the latest CO-11 and CO-11a.)

II. STEP-BY-STEP INSTRUCTIONS

Change Order Log

1 Save a copy of the previous Change Order spreadsheet file and name it as noted in the preceding paragraph.

2 Click on the "Contract Summary and Change Order Log" tab.

3 In the "Contract Summary" section, enter new (or verify existing) data for the cells hignlighted in yellow.

4 In the "Change Order Log" section, enter the following information:

- **Change Order Number**
  - Change Order Numbers are sequential integer numbers. Start with "1".
  - Enter change orders sequentially in the log - starting with the lowest number change order. (See the note below for projects aready in progess.)
  - Don't skip rows between change orders (i.e., don't leave any blank rows between change order entries) or else erroneous results will occur.

- **Change Order Date** (enter in mm/dd/yy format)

- **Change Order Amount** (enter the total value of latest Change Order)

- **Schedule Extension** (enter the additional number of days the contract will be extended due to latest Change Order)

(All other information shown on the log is computed automatically and is used elsewhere in the spreadsheet.)

NOTE: If this spreadsheet is being implemented for a project already in progress, there are two options for entering Change Orders which were issued prior to this new spreadsheet becoming available:

a) Enter all Change Orders as individual line items in the Log (recommended method), or

b) Group all Change Orders already executed under one line entry. After this one "catch up entry", enter all subsequent Change Orders as individual line items.

5 Print a copy of the Log, if desired, using the File/Print menu command. (To limit the number of pages printed, enter the appropriate page numbers in the "Pages" section of the "Print Range" dialog box.)

CO-11 Part 1, Construction Change Order (Summary of Work)

Part 1 of the CO-11 lists the summary cost and contract completion information related to the current change, the cumulative cost and completion data, and provides signature lines for all affected parties.

1 Enter the specific Change Order Number for which you wish to create a CO-11 and CO-11a. (NOTE: The Contract Summary and Change Order Log must be complete for all Change Orders up to and including this Change Order.)

2 Type in the name and title of the various signatories to this Change Order.

3 Print a copy of the CO-11 Part 1 using the File/Print menu command or the printer icon. (You can also use the Print or Print Preview buttons on the toolbar below.)

CO-11 Part 2, Construction Change Order (Itemization of Work)

Part 2 of the CO-11 provides an itemized breakdown of the scope of work to be performed.

1 Enter the required data for the each of the five columns highlighted in yellow. Additional data entry instructions are provided as each cell is selected.

2 Once all detail line items have been entered, verify that the sum of all detail line items match the total amount entered earlier in the Change Order Log for this Change Order. If the amount in the Change Order Log and the sum of the Part 2 detail entries do not match, an error message will appear in red at the top of the Part 2 sheet. Correct either the detail amounts in Part 2 or the total amount entered in the Change Order Log, as needed. Once the amounts match, the error message will clear.

3 An asterisk (*) appearing adjacent to the amount field on Part 2, denotes that either the "Initiated By" or the "Reason for Change" fields, or both, were not completed properly. (An entry must appear in both of these fields, if an associated dollar amount was entered.) Fill in these fields with the appropriate entries to clear these error flags.

4 Once the errors described in 2 and 3 above have been corrected, print a copy of this sheet using the File/Print menu command. To limit the number of pages printed, enter the appropriate page numbers in the "Pages" section of the "Print Range" dialog box.

CO-11a Part 1, Change Order Justification (A/E's Justification)

Part 1 of the CO-11a is completed by the A/E to:
- provide a brief narrative summary of work to be performed
- explain why the change is required
- identify the A/E's recommendation to the Agency

1 Describe the work.

2 Describe why change is required.

3 Use the drop-down arrow to select either "Recommend Approval" or "Recommend Disapproval".

4 Print out the CO-11a Part 1 and obtain signature of the authorized A/E representative.

CO-11a Part 2, Change Order Justification (Agency's Justification)

Part 2 of the CO-11a is completed by the Agency to:
- verify that adequate contingency is available
- identify cost sharing arrangements for design errors or omissions
- justify Change Orders which are a result of a change in agency requirements

1 Enter the latest APPROVED CO-8 Contingency amount.

If sufficient contingency is available to accommodate this Change Order, the balance remaining after approval of this Change Order will be displayed.

If the contingency balance is insufficient, the minimum amount of additional contingency required to accommodate this Change Order will be displayed. Submit a revised CO-8 concurrent with the Change Order to increase the construction change order contingency amount.

2 Complete the two items of information needed for Change Orders which involve "design errors and omissions".

3 Complete the four items of information needed for Change Orders which involve "changes in agency requirements".

4 Print out the CO-11a Part 1 and obtain signature of the authorized Agency representative.

CO-11a Part 3, Change Order Justification (Agency's Justification)

Part 3 of the CO-11a is a statistical summary compiled automatically from the entries on Part 2 of the CO-11.

1 Verify that the total on this sheet matches the total Change Order amount. If the total on this sheet is incorrect, return to Part 2 of the CO-11 sheet and ensure that all lines with an "Amount" have a corresponding "Reason Code".

2 Once correct, print out a copy of this sheet.

III. SUBMITTAL REQUIREMENTS

If approval by DGS is required:

Submit a "hard copy" of all items identified on the Submittal Requirements section of the Transmittal to DEB immediately after all other applicable signatures have been obtained.

Include copies of additional supporting backup (e.g., GC-1, SC-1, and SS-1 forms, if used, drawings/sketches, and other additional backup). This is necessary to provide the Director of the Department of General Services, functioning as the Governor's Designee, sufficient data to understand, evaluate, and approve the proposed Change Order.

If approval by DGS is not required:

CONTRACT SUMMARY:

	Code Number	Description
Agency:		
Project:		
Sub-Project:		
Location of the Work:		
Contractor Name:		
Architect/Engineer:		

Agency has delegated authority ?	NO				
Date Contract Ratified:			**Original Contract**		
			Additive Changes		0.00
Original Contract Completion Date:			Deductive Changes		0.00
Cumulative Schedule Extensions:	0	days	**Total Changes**	$ -	0.0%
Revised Contract Completion Date:	01/00/00		**Revised Contract**	$ -	

CHANGE ORDER LOG:

Updated thru Change Order Number: 0

Change Order Number	Change Order Date	Change Order Amount	Schedule Extension (days)	Governor's Designee's Approval Required?	Cumulative Change Orders	Revised Contract Value	Cumul. Schedule Extension (days)	Revised Contract Completion Date
					$ -		0	

CHANGE ORDER LOG:

Updated thru Change Order Number: 0

Change Order Number	Change Order Date	Change Order Amount	Schedule Extension (days)	Governor's Designee's Approval Required?	Cumulative Change Orders	Revised Contract Value	Cumul. Schedule Extension (days)	Revised Contract Completion Date

CHANGE ORDER LOG:

Updated thru Change Order Number: 0

Change Order Number	Change Order Date	Change Order Amount	Schedule Extension (days)	Governor's Designee's Approval Required?	Cumulative Change Orders	Revised Contract Value	Cumul. Schedule Extension (days)	Revised Contract Completion Date

DGS-30-092 (Rev. 02/24)

CONTRACT CHANGE ORDER
(Summary of Work)

CO-11 Part 1

Project Code	Change Order Number	Change Order Date
		#N/A

	Code	Description
Agency:	0	0
Project:	0	0
Sub-Project:	0	

To: 0

Under your contract dated January 0, 1900 for work at
0
#
the Contract Price, in accordance with the Contract Documents, the sum of #N/A

#VALUE!

#

#

Failure to include a specific change in the Contract Completion Date in this Change Order is a waiver to any future adjustment to the Contract Completion Date for the Work and impact of this Change Order unless the parties mutually agree in writing to postpone a determination on any change to the Contract Completion Date, which determination may not be postponed for more than 45 days from the Agency's approval of this Change Order. If no determination is reached within the 45-day period, the extension to the Contract Completion Date shall be 0 Days.

CONTRACT COST SUMMARY
(inclusive of this Change Order)

Original Contract Amount	$0.00
Cumulative Change Orders	#N/A
Revised Contract Amount	#N/A

CONTRACT SCHEDULE SUMMARY
(inclusive of this Change Order)

Original Contract Completion Date:	January 0, 1900
Cumulative Schedule Extension:	#N/A
Revised Contract Completion Date:	#N/A

CHANGE AUTHORIZATION

Authorized A/E Representative	*Date*
Authorized Contractor Representative	*Date*
Authorized Agency Representative	*Date*
Authorized Agency Representative	*Date*

Prior approval by the Governor or his designee is required for each Change Order which causes an increase in the Contract Price if the resulting cumulative sum of all Change Orders exceeds **25% of the original Contract Amount** or **$50,000**, whichever is greater.

#N/A

Recommended By:

Director, Division of Engineering and Buildings	*Date*

Approved By:

Director, Department of General Services	*Date*

DGS-30-092 **(Rev. 02/24)**

CONTRACT CHANGE ORDER

CO-11

By" and "Reason for Change"

(Itemization of Work)

Part 2

Project Code	Change Order Number	Change Order Date
	0	#N/A

#N/A **#N/A**

Change Order Total (sum of the details listed below) = **$ -**

#N/A

#N/A

Reference Number	Description / Comments	Initiated By	Reason Code	Amount

Reference Number	Description / Comments	Initiated By	Reason Code	Amount

DGS-30-096
(Rev. 02/24)

CHANGE ORDER JUSTIFICATION
(Architect / Engineer's Justification)

CO-11a
Part 1

Project Code	Change Order Number	Change Order Date
	0	#N/A

A/E's DESCRIPTION OF WORK INVOLVED

A/E's EXPLANATION OF WHY WORK IS REQUIRED

A/E's RECOMMENDATION

Select One

Architect / Engineer

Date

DGS-30-096
(Rev. 02/24)

CHANGE ORDER JUSTIFICATION
(Agency's Justification)

CO-11a
Part 2

Project Code	Change Order Number	Change Order Date
	0	#N/A

ADDITIONAL CONTINGENCY REQUIRED ?

Construction Contingency Amount Shown on Last Approved CO-8:

Cumulative Amount Of All Change Orders To-Date, Inclusive Of This Change Order: #N/A

#N/A #N/A

Remarks:

COST SHARING FOR DESIGN ERRORS AND OMISSIONS

Is this change order required in whole, or in part, because of a design error or omission? No

If "Yes", outline the proposed cost sharing, if any, by the responsible design professional:

ADDITIONAL SUPPORT FOR CHANGES IN AGENCY REQUIREMENTS

1) When was the change in requirements (function, mission) known?

2) If known before construction bidding, why were the needed changes excluded from the bid package?

3) What quantitative impact would the lack of this change have on the mission or service provided by the agency?

4) Why can the work not be packaged and bid separately?

By: _____ _____
Agency Representative Date

DGS-30-096
(Rev. 02/24)

CHANGE ORDER JUSTIFICATION
(Statistical Summary)

CO-11a
Part 3

Project Code	Change Order Number	Change Order Date
	0	#N/A

Reason Code		Amount		Reason Code Description
1	$		-	1 - Unforeseen site conditions
2	$		-	2 - Existing building or utility conditions not as shown
3	$		-	3 - Change in agency's requirements
4	$		-	4 - Substitution or alternate method
5	$		-	5 - Item not as shown or specified
6	$		-	6 - Conflict or discrepancy in requirements
7	$		-	7 - Other.
Total	**$**		**-**	

Transmittal for DEB Review Services

PROJECT

	Agency #	Project #	Subproj.#		
Project Code:	0 -	0 -	0	Date Submitted:	
				Submitted By:	
Agency:	0				
Project Title:	0				
Subproject Title:	0				
Remarks:					

CONTACTS

	Agency Contact	Architect/Engineer Contact
Agency/Firm Name:		
Contact Name:		
Contact Phone #:		
Contact E-mail:		

SUBMITTAL REQUIREMENTS

Construction Change Order	Total Construction Change Orders exceed:		
	25% of the original Contract Price or $50,000, whichever is greater	50% of the original Contract Price or $500,000, whichever is greater	100% of the original Contract Price or $1,000,000, whichever is greater
	(Identify the number of copies of each document submitted in the boxes below)		
Cover letter with description of change and indication if work is already complete.			
Use form DGS-30-092 (CO-11)			
Use form DGS-30-096 (CO-11a)			
Use form DGS-30-200 (GC-1)			
Use form DGS-30-204 (SC-1) as needed			
Use form DGS-30-208 (SS-1) as needed			
Cover letter must be from agency head.			
DEB Recommends and emergency declaration in the manner provided in § 2.2-4303			

	Yes	No
Are funds available within the project to cover the added costs that this change order will cause?		
Does this change order add sq. ft. to the project?		
If yes, specify total sq. ft. added		

ADDITIONAL INFORMATION

Provide a description of the key factors that caused the aggregate construction change orders to increase the contract by this magnitude.

NOTE: The "DGS-30..." forms referenced above are available from the DGS Forms Center

GENERAL CONTRACTOR ESTIMATE FOR CHANGE ORDER

DGS-30-200
(Rev. 03/16)

GC-1

Project Code: | **General Contractor:**
Agency: | **Change Description:**
Project:

GENERAL CONTRACTOR DIRECT COSTS

Scope Description		Direct Labor				Direct Material				Direct Equipment			
Item No.	Description	Direct Labor Hours	Labor Units (Manhours, Crew Hours)	Hourly Wage Rate, Excl. Taxes & Ins.	Total Labor Cost	Quantity	Qty Units	Material Cost Per Unit	Total Material Cost	Quantity	Qty Units	Equipment Cost Per Unit	Total Equipment Cost
A	B	C	D	E	F=C x E	G	H	I	J = G x I	K	L	M	N = K x M
1.01					$0.00	1.00		$100.00	$100.00				$0.00
1.02					$0.00				$0.00				$0.00
1.03					$0.00				$0.00				$0.00
1.04					$0.00				$0.00				$0.00
1.05					$0.00				$0.00				$0.00
1.06					$0.00				$0.00				$0.00
1.07					$0.00				$0.00				$0.00
1.08					$0.00				$0.00				$0.00
1.09	**Subtotal from Estimate Continuation Sheets**				$0.00				$0.00				$0.00
1.97	**Subtotal (S/T) Direct Costs:**			**Subtotal Labor**	**$0.00**			**Subtotal Material**	**$100.00**			**Subtotal Equipment**	**$0.00**
1.98	**Taxes/Insurance:**	**FICA, FUI, SUI, & Workmens' Comp.**		% of Labor	$0.00		Sales Tax	0.0%			Sales Tax		
1.99	**Total Direct Costs**			**Total Labor**	$0.00			**Total Material**	$100.00			**Total Equipment**	$0.00

SUBCONTRACT COSTS

Item No.	Subcontractor Name (List totals from attached SC-1 forms)	Total Cost
A	B	C
2.01		
2.02		
2.03		
2.04		
2.05		
2.06		
2.07		
2.08		
2.09		
2.99	**Total Subcontract Costs**	$0.00

SUMMARY

Item No.	Description		Total Cost
3.01	Total Direct Labor Cost	Item 1.99H	$0.00
3.02	Total Direct Material Cost	Item 1.99J	$100.00
3.03	Total Equipment Cost	Item 1.99L	$0.00
3.04	Subtotal	3.01+3.02+3.03	$100.00
3.05	Overhead and Profit* (%)		$0.00
3.06	Subtotal	3.04+3.05	$100.00
3.07	Subcontractor Cost	Item 2.99	$0.00
3.08	GC Markup on Subcontractors** (%)		$0.00
3.09	Subtotal	3.06+3.07+3.08	$100.00
3.10	Additional Bond Cost		
3.99	**Total Change Order Cost**	(3.09+3.10)	$100.00

Name:

Signature:

Title:

Date:

I have reviewed the costs proposed and find them to be reasonable (as proposed) (as marked).

A/E Signature:

Note: Mark-up is capped in conformance with the provisions of the General Conditions (CO-7).
*Limited to 15% on self-performed work.
**Limited to a total of 10%, shared (cumulative total) if multiple tier subs, on subcontracted work. See Mark-up limitations for a more detailed description.

ESTIMATE CONTINUATION SHEET

(Attach to Form GC-1, SC-1, or SS-1 as necessary for continuation of the direct cost estimates.)

Project Code: 0
Agency: 0
Project: 0

Performing Contractor: 0

Change Description: 0

PERFORMING CONTRACTOR DIRECT COSTS													
Scope Description		Direct Labor				Direct Material				Direct Equipment			
Item No.	Description	Direct Labor Hours	Labor Units (Manhours, Crew Hours)	Hourly Wage Rate, Excl. Taxes & Ins.	Total Labor Cost	Quantity	Qty Units	Material Cost Per Unit	Total Material Cost	Quantity	Qty Units	Equipment Cost Per Unit	Total Equipment Cost
A	B	C	D	E	F=C x E	G	H	I	J = G x I	K	L	M	N = K x M
					$0.00				$0.00				$0.00

SUBCONTRACTOR ESTIMATE FOR CHANGE ORDER

DGS-30-204
(Rev. 03/16)

SC-1

Project Code: _____ **General Contractor:** _____
Agency: _____ **Subcontractor:** _____
Project: _____ **Subcontractor Trade:** _____

Change Description: _____

SUBCONTRACTOR DIRECT COSTS

Scope Description		Direct Labor				Direct Material				Direct Equipment			
Item No.	Description	Direct Labor Hours	Labor Units (Manhours, Crew Hours)	Hourly Wage Rate, Excl. Taxes & Ins.	Total Labor Cost	Quantity	Qty Units	Material Cost Per Unit	Total Material Cost	Quantity	Qty Units	Equipment Cost Per Unit	Total Equipment Cost
A	B	C	D	E	F=C x E	G	H	I	J = G x I	K	L	M	N = K x M
1.01					$0.00				$0.00				$0.00
1.02					$0.00				$0.00				$0.00
1.03					$0.00				$0.00				$0.00
1.04					$0.00				$0.00				$0.00
1.05					$0.00				$0.00				$0.00
1.06					$0.00				$0.00				$0.00
1.07					$0.00				$0.00				$0.00
1.08					$0.00				$0.00				$0.00
1.09	**Subtotal from Estimate Continuation Sheets**				$0.00				$0.00				$0.00
1.97	**Subtotal (S/T) Direct Costs:**			**Subtotal Labor**	**$0.00**			**Subtotal Material**	**$0.00**			**Subtotal Equipment**	**$0.00**
1.98	**Taxes/Insurance:**	**FICA, FUI, SUI, & Workmens' Comp.**		% of Labor	$0.00			Sales Tax				Sales Tax	
1.99	**Total Direct Costs**			**Total Labor**	$0.00			**Total Material**	$0.00			**Total Equipment**	$0.00

SUB-SUBCONTRACT COSTS

Item No.	Sub-Subcontractor Name (List totals from attached SS-1 forms)	Total Cost
A	B	C
2.01		
2.02		
2.03		
2.04		
2.05		
2.06		
2.99	**Total Sub-Subcontract Costs**	$0.00

SUMMARY

Item No.	Description		Total Cost
3.01	Total Direct Labor Cost	Item 1.99H	$0.00
3.02	Total Direct Material Cost	Item 1.99J	$0.00
3.03	Total Equipment Cost	Item 1.99L	$0.00
3.04	Subtotal	3.01+3.02+3.03	$0.00
3.05	Overhead and Profit* (%)		$0.00
3.06	Total Subcontractor Cost	3.04+3.05	$0.00
3.07	Sub-Subcontractor Cost **	Item 2.99	$0.00
3.99	**S/C Cost to GC-1 Form*** **	3.06+3.07	$0.00

Submitted By

Name: _____

Signature: _____

Title: _____

Date: _____

Note: Mark-up is capped in conformance with the provisions of the General Conditions (CO-7).

*Limited to 15% on self-performed work.

**Limited to a total of 10%, shared (cumulative total) if multiple tier subs, on subcontracted work. Total mark-up on subcontracted work is calculated on the GC-1 form. See mark-up limitations for a more detailed description.

*** The subcontractor cost carried forward to GC-1 form does not include mark-up on sub-subcontractor costs. This mark-up is calculated on the GC-1 form. The GC and its subcontractors shall establish how the mark-up is to be distributed among the various subcontractors involved in the work.

ESTIMATE CONTINUATION SHEET

(Attach to Form GC-1, SC-1, or SS-1 as necessary for continuation of the direct cost estimates.)

Project Code: 0 **Performing Contractor:** 0
Agency: 0
Project: 0

Change Description: 0

PERFORMING CONTRACTOR DIRECT COSTS													
Scope Description		Direct Labor				Direct Material				Direct Equipment			
Item No.	Description	Direct Labor Hours	Labor Units (Manhours, Crew Hours)	Hourly Wage Rate, Excl. Taxes & Ins.	Total Labor Cost	Quantity	Qty Units	Material Cost Per Unit	Total Material Cost	Quantity	Qty Units	Equipment Cost Per Unit	Total Equipment Cost
A	B	C	D	E	F=C x E	G	H	I	J = G x I	K	L	M	N = K x M
					$0.00				$0.00				$0.00

SUB-SUBCONTRACTOR ESTIMATE FOR CHANGE ORDER

DGS-30-208
(Rev. 03/16)

SS-1

Project Code: | **General Contractor:**
Agency: | **Subcontractor:**
Project: | **Sub-Subcontractor:**
Sub-Subcontractor Trade:
Change Description:

SUB-SUBCONTRACTOR DIRECT COSTS

Scope Description		Direct Labor				Direct Material				Direct Equipment			
Item No.	Description	Direct Labor Hours	Labor Units (Manhours, Crew Hours)	Hourly Wage Rate, Excl. Taxes & Ins.	Total Labor Cost	Quantity	Qty Units	Material Cost Per Unit	Total Material Cost	Quantity	Qty Units	Equipment Cost Per Unit	Total Equipment Cost
A	B	C	D	E	F=C x E	G	H	I	J = G x I	K	L	M	N = K x M
1.01					$0.00				$0.00				$0.00
1.02					$0.00				$0.00				$0.00
1.03					$0.00				$0.00				$0.00
1.04					$0.00				$0.00				$0.00
1.05					$0.00				$0.00				$0.00
1.06					$0.00				$0.00				$0.00
1.07					$0.00				$0.00				$0.00
1.08					$0.00				$0.00				$0.00
1.09	**Subtotal from Estimate Continuation Sheets**				$0.00				$0.00				$0.00
1.97	**Subtotal (S/T) Direct Costs:**			**Subtotal Labor**	**$0.00**			**Subtotal Material**	**$0.00**			**Subtotal Equipment**	**$0.00**
1.98	**Taxes/Insurance:**	**FICA, FUI, SUI, & Workmens' Comp.**		% of Labor	$0.00			Sales Tax				Sales Tax	
1.99	**Total Direct Costs**			**Total Labor**	$0.00			**Total Material**	$0.00			**Total Equipment**	$0.00

SUMMARY

Item No.	Description		Total Cost
3.01	Total Direct Labor Cost	Item 1.99H	$0.00
3.02	Total Direct Material Cost	Item 1.99J	$0.00
3.03	Total Equipment Cost	Item 1.99L	$0.00
3.04	Subtotal	3.01+3.02+3.03	$0.00
3.05	Overhead and Profit* (%)		$0.00
3.99	**Total Sub-Subcontractor**		$0.00

Submitted By

Name:
Signature:
Title:
Date:

Note: Mark-up is capped in conformance with the provisions of the General Conditions (CO-7).
*Limited to 15% on self-performed work. See Mark-up limitations for a more detailed description.

ESTIMATE CONTINUATION SHEET

(Attach to Form GC-1, SC-1, or SS-1 as necessary for continuation of the direct cost estimates.)

Project Code: 0 **Performing Contractor:** 0
Agency: 0
Project: 0

Change Description: 0

PERFORMING CONTRACTOR DIRECT COSTS													
Scope Description		Direct Labor				Direct Material				Direct Equipment			
Item No.	Description	Direct Labor Hours	Labor Units (Manhours, Crew Hours)	Hourly Wage Rate, Excl. Taxes & Ins.	Total Labor Cost	Quantity	Qty Units	Material Cost Per Unit	Total Material Cost	Quantity	Qty Units	Equipment Cost Per Unit	Total Equipment Cost
A	B	C	D	E	F=C x E	G	H	I	J = G x I	K	L	M	N = K x M
					$0.00				$0.00				$0.00

DGS-30-104 (FORM CO-12) (Rev. 02/25)	SCHEDULE OF VALUES and CERTIFICATE FOR PAYMENT	PAYMENT REQUEST NO.	1
PART A SUMMARY AND CERTIFICATION		PERIOD BEGINNING DATE:	01/00/1900
		PERIOD ENDING DATE:	01/00/1900

PROJECT CODE: 0
AGENCY NAME: 0
PROJECT TITLE: 0

	TOTAL VALUE	VALUE OF WORK COMPLETED			PERCENT COMPLETE
		PREVIOUS VALUE TO DATE	VALUE THIS REPORT	CURRENT VALUE TO DATE	
	A	B	C	D = B + C	E = D / A
Original Contract Line Items (from CO-12, PART B)	$ -	$ -	$ -	$ -	0%
Approved Change Orders (from CO-12, PART C)	$ -	$ -	$ -	$ -	0%
ADJUSTED CONTRACT TOTAL	**$ -**	**$ -**	**$ -**	**$ -**	0%
Retainage *Retainage Percentage:* #DIV/0!		$ -	$ -	$ -	
NET REQUISTION AMOUNT		**$ -**	**$ -**	**$ -**	
			Amount Requested		

CONTRACTOR CERTIFICATION

The undersigned Contractor requests payment of that portion of the contract price shown on the last line of the foregoing Schedule of Values, and represents and warrants to the Owner that: (1) the data shown on the Schedule of Values is accurate and correct; (2) the Work covered by this Certificate has been completed in accordance with the Contract Documents; (3) all previous progress payments received from Owner on account of Work done under this Contract have been applied to discharge in full (except for allowable retainage) all obligations of Contractor incurred in connection with Work covered by prior Certificates for Payment (not applicable for Pay Request 1) ; (4) title to all materials and equipment for which payment is requested in this Certificate, whether or not incorporated in said Work, will pass to Owner at time of payment free and clear of all liens, claims, security interests and encumbrances (except such materials and equipment which are covered by a Bond previously accepted by Owner).

FEIN #: *** enter FEIN in Step 2 *** **Contractor:** *** enter Contractor name in Step 2 ***

Date: January 0, 1900 **By:** _____
signature

Typed Name: *** enter Contractor Representative's Name in Step 3 ***

ARCHITECT/ENGINEER CERTIFICATION

This is to certify that, in accordance with the terms of a contract for Project Number executed the day of , by and between, , the contractor, and the Commonwealth of Virginia, , the Owner, for work at , there is due to the Contractor the amount of No Dollars and No Cents $.00

Architect/Engineer:

By: _____ _____ _____
signature *printed name* *date*

AGENCY ACTION

Amount approved for payment this certificate is: _____

_____ Dollars (_____)

By: _____ _____ _____
signature *title* *date*

By: _____ _____ _____
signature *title* *date*

DGS-30-104 (FORM CO-12) (Rev. 02/25)	SCHEDULE OF VALUES AND CERTIFICATE FOR PAYMENT		PAYMENT REQUEST NO.	1
PART B	PROJECT CODE:	0.00	PERIOD BEGINNING DATE:	01/00/1900
ORIGINAL CONTRACT LINE ITEMS	AGENCY NAME:	0	PERIOD ENDING DATE:	01/00/1900
	PROJECT TITLE:	0		

ITEM NO.	BUILDING ELEMENT	ADDITIONAL DESCRIPTION	TOTAL VALUE	VALUE OF WORK COMPLETED			PERCENT COMPLETE	LINE ITEM RETAINAGE (PERCENT)	LINE ITEM RETAINAGE AMOUNT	VENDOR NAME	Micro	Small	Woman	Minority	Dis Vet	DSBSD CERTIFICATE NUMBER
				PREVIOUS VALUE TO DATE	VALUE THIS REPORT	CURRENT VALUE TO DATE										
				$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
				$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
			$ -	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	
				$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
				$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
				$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
				$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
				$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
				$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
				$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
				$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
				$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
				$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
		DO NOT EDIT OR DELETE. See 2nd note in red above.		$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
TOTAL ORIGINAL CONTRACT			$ -	$ -	$ -	$ -	0%	0%	$ -							

DGS-30-104 (FORM CO-12) (Rev. 02/25)	SCHEDULE OF VALUES AND CERTIFICATE FOR PAYMENT		PAYMENT REQUEST NO.	1
PART C	PROJECT CODE:	0.00	PERIOD BEGINNING DATE:	01/00/1900
CONSTRUCTION CHANGE ORDERS	AGENCY NAME:	0	PERIOD ENDING DATE:	01/00/1900
	PROJECT TITLE:	0		

			VALUE OF WORK COMPLETED												
CHNG. ORD. NO.	ITEM DESCRIPTION	TOTAL VALUE	PREVIOUS VALUE TO DATE	VALUE THIS REPORT	CURRENT VALUE TO DATE	PERCENT COMPLETE	LINE ITEM RETAINAGE (PERCENT)	LINE ITEM RETAINAGE AMOUNT	VENDOR NAME	Micro	Small	Woman	Minority	Dis Vet	DSBSD CERTIFICATE NUMBER
			$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
			$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
			$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
			$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
			$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
			$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
			$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
			$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
			$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
			$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
	DO NOT EDIT OR DELETE. See 2nd note in red above.		$ -	$ -	$ -		5%	$ -		N	N	N	N	N	
TOTAL APPROVED CHANGE ORDERS		$ -	$ -	$ -	$ -	0%	0%	$ -							

STEP 7 - Print the CO-12

PART B Instructions

The **ORIGINAL CONTRACT** line items (and progress for same) are entered in PART B of the CO-12 form.
Below is an example PART B with detailed instructions shown in red.

ITEM NO.	BUILDING ELEMENT	ADDITIONAL DESCRIPTION	TOTAL VALUE	VALUE OF WORK COMPLETED			PERCENT COMPLETE	LINE ITEM RETAINAGE (PERCENT)	LINE ITEM RETAINAGE AMOUNT	VENDOR NAME	Micro	Small	Woman	Minority	Dis Vet	DSBSD CERTIFICATE NUMBER
				PREVIOUS VALUE TO DATE	VALUE THIS REPORT	CURRENT VALUE TO DATE										
100 L	B1010 Floor Construction	Structural Steel Material	$ 5,675.00	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	

Enter a unique number for each line item. (Examples: 1, 2, 3….. 1A, 1B, 1C…… 100, 200, 300….. 100.1, 100.2, 100.3.) No specific format is mandated for Item Number field.

500	G2020 Parking Lots	Lot A	$ 30,000.00	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	

A1010 Standard Foundations
A1020 Special Foundations
A1030 Slab on Grade
A2010 Basement Excavation
A2020 Basement Walls
B1010 Floor Construction
B1020 Roof Construction
B2010 Exterior Walls

Select a Building Element from the ASTM Uniformat list. Building Elements may be entered multiple times.

Enter additional description of the work item (e.g., floor, wing, etc.), as needed, to provide sufficient detail for progress to be assessed.
(For Example: 1st Floor, 2nd Floor, …., East Wing, West Wing, …., Chiller A, Chiller B, …. etc.)

501	G2020 Parking Lots	Lot B	$ 50,000.00	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	

If payment will be sought for stored materials, labor and materials must be shown on separate lines.
Provide other supporting documentation as required by the General Conditions.

100 L	B1010 Floor Construction	Structural Steel Material	$ 5,675.00	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	
100 M	B1010 Floor Construction	Structural Steel Installation	$ -	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	

Enter the original contract value for each line item.

100 L	B1010 Floor Construction	Structural Steel Material	$ 5,675.00	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	

Do not enter data in these columns. (These values are computed by worksheet formulas.)

500	G2020 Parking Lots	Lot A	$ 30,000.00	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	

Enter the total progress (percent complete) for each line item. Enter the retainage percentage for each line item.

501	G2020 Parking Lots	Lot B	$ 50,000.00	$ -	$ 22,500.00	$ 22,500.00	45%	5%	$ 1,125.00		N	N	N	N	N	

If subcontractor is a Small (S), Woman (W), or Minority (M) - owned business, enter vendor name, and Yes (Y) or No (N) for S, W, M status.

502	G2020 Parking Lots	Lot C	$ 30,000.00	$ -	$ 7,500.00	$ 7,500.00	25%	5%	$ 375.00	Smith's Paving Services	N	N	N	N	N	99999-999

If subcontractor is a Small (S), Woman (W), or Minority (M) - owned business, enter their Department of Minority Business Enterprise (DMBE) certificate number.

PART C Instructions

The **CONSTRUCTION CHANGE ORDERS** (and progress for same) are entered in PART C of the CO-12 form.
Below is an example PART C with detailed instructions shown in red.

ITEM NO.	BUILDING ELEMENT	TOTAL VALUE	VALUE OF WORK COMPLETED			PERCENT COMPLETE	LINE ITEM RETAINAGE (PERCENT)	LINE ITEM RETAINAGE AMOUNT	VENDOR NAME	Micro	Small	Woman	Minority	Dis Vet	DSBSD CERTIFICATE NUMBER
			PREVIOUS VALUE TO DATE	VALUE THIS REPORT	CURRENT VALUE TO DATE										
1	ADDITIONAL LANDSCAPING	$ 10,000.00	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	

Enter the Change Order Number. (Examples: 1, 2, 3…..). Additional identifying numbers and/or letters may be added as shown in examples below as needed.

1a	ADDITIONAL LANDSCAPING - Additional trees and shrubs	$ 6,000.00	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	
1b	ADDITIONAL LANDSCAPING - Extend irrigation system	$ 4,000.00	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	

If necessary to provide more detail for a specific Change Order, use multiple lines for each component as needed.

3	EPDM Roofing	$ -	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	

Enter a Change Order description. (Line items must be broken out in a sufficient level of detail to allow Owner and A/E to assess progress.)

If payment will be sought for stored materials, labor and materials must be entered on separate lines.

4 L	Structural Steel - Installation	$ -	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	
4 M	Structural Steel - Materials	$ -	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	

Enter the scheduled value for each Change Order or component thereof.

5 L	Structural Steel - Installation	$ 5,675.00	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	

Do not enter data in these columns. (These values are computed by worksheet formulas.)

6.1	Pave Parking Lot A	$ 30,000.00	$ -	$ -	$ -	0%	5%	$ -		N	N	N	N	N	

Enter the total progress (percent complete) for each line item.

6.2	Pave Parking Lot B	$ 50,000.00	$ -	$ 37,500.00	$ 37,500.00	75%	5%	$ 1,875.00		N	N	N	N	N	

If subcontractor is a Small (S), Woman (W), or Minority (M) - owned business, enter vendor name, and Yes (Y) or No (N) for S, W, M status.

6.3	Pave Parking Lot C	$ 30,000.00	$ 10,000.00	$ 20,000.00	$ 30,000.00	100%	5%	$ 1,500.00	Smith's Paving Services	N	N	N	N	N	99999-999

If subcontractor is a Small (S), Woman (W), or Minority (M) - owned business, enter their Department of Minority Business Certificate (DMBE) certificate number.

Use the Level III classification to describe Building Elements in the Schedule of Values.

Extracted, with permission, from ASTM E1557-09 Standard Classification for Building Elements and Related Sitework-UNIFORMAT II, copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.
(Click here to visit astm.org)

Level I	Level II	Level III
A Substructure	A10 Foundations	A1010 Standard Foundations
		A1020 Special Foundations
		A1030 Slab on Grade
	A20 Basement Construction	A2010 Basement Excavation
		A2020 Basement Walls
B Shell	B10 Superstructure	B1010 Floor Construction
		B1020 Roof Construction
	B20 Exterior Enclosure	B2010 Exterior Walls
		B2020 Exterior Windows
		B2030 Exterior Doors
	B30 Roofing	B3010 Roof Coverings
		B3020 Roof Openings
C Interiors	C10 Interior Construction	C1010 Partitions
		C1020 Interior Doors
		C1030 Fittings
	C20 Stairs	C2010 Stair Construction
		C2020 Stair Finishes
	C30 Interior Finishes	C3010 Wall Finishes
		C3020 Floor Finishes
		C3030 Ceiling Finishes
D Services	D10 Conveying	D1010 Elevators & Lifts
		D1020 Escalators & Moving Walks
		D1090 Other Conveying Systems
	D20 Plumbing	D2010 Plumbing Fixtures
		D2020 Domestic Water Distribution
		D2030 Sanitary Waste
		D2040 Rain Water Drainage
		D2090 Other Plumbing Systems
	D30 HVAC	D3010 Energy Supply
		D3020 Heat Generating Systems
		D3030 Cooling Generating Systems
		D3040 Distribution Systems
		D3050 Terminal & Package Units
		D3060 Controls & Instrumentation
		D3070 System Testing & Balancing
		D3090 Other HVAC Systems & Equipment
	D40 Fire Protection	D4010 Sprinklers
		D4020 Standpipes
		D4030 Fire Protection Specialties
		D4090 Other Fire Protection Systems
	D50 Electrical	D5010 Electrical Service & Distribution
		D5020 Lighting and Branch Wiring
		D5030 Communications & Security
		D5090 Other Electrical Systems
E Equipment & Furnishings	E10 Equipment	E1010 Commercial Equipment
		E1020 Institutional Equipment
		E1030 Vehicular Equipment
		E1090 Other Equipment
	E20 Furnishings	E2010 Fixed Furnishings
		E2020 Movable Furnishings

	F Special Construction & Demolition	F10 Special Construction	F1010 Special Structures
			F1020 Integrated Construction
			F1030 Special Construction Systems
			F1040 Special Facilities
			F1050 Special Controls and Instrumentation
		F20 Selective Building Demolition	F2010 Building Elements Demolition
			F2020 Hazardous Components Abatement
	G Sitework & Utilities	G10 Site Preparation	G1010 Site Clearing
			G1020 Site Demolition and Relocations
			G1030 Site Earthwork
			G1040 Hazardous Waste Removal
		G20 Site Improvements	G2010 Roadways
			G2020 Parking Lots
			G2030 Pedestrian Paving
			G2040 Site Development
			G2050 Landscaping
		G30 Site Mechanical Utilities	G3010 Water Supply
			G3020 Sanitary Sewer
			G3030 Storm Sewer
			G3040 Heating Distribution
			G3050 Cooling Distribution
			G3060 Fuel Distribution
			G3090 Other Site Mechanical Utilities
		G40 Site Electrical Utilities	G4010 Electrical Distribution
			G4020 Site Lighting
			G4030 Site Communications & Security
			G4090 Other Site Electrical Utilities
		G90 Other Site Construction	G9010 Services and Pedestrian Tunnels
			G9090 Other Site Systems & Equipment
*	Z Gen'l. Cond. / OH&P	Z Gen'l. Cond. / OH&P	Z0000 General Conditions / Gen'l Requirements, OH & P

* - The last entry above is not part of the referenced ASTM Uniformat II classification standard.

COMMONWEALTH OF VIRGINIA
AFFIDAVIT OF PAYMENT OF CLAIMS

By:

This day _____ personally appeared before me, _____, a Notary Public in and for the City (County) of _____, _____ and, being by me first duly sworn, states that all subcontractors and suppliers of labor and materials have been paid all sums due them for work performed or materials furnished in the performance of the Contract between the Commonwealth of Virginia, _____, Owner, and _____ , Contractor, dated _____,20 ___ , for the construction of _____ _____

_____

or arrangements have been made by the Contractor satisfactory to such subcontractors and suppliers with respect to payments of such sums as may be due them by the Contractor.

Typed Contractor Name

By:

Signature

Typed Name &Title of Person Signing

Subscribed and sworn to before me this _____ day of _____ , 20____. My commission expires on the _____ day of _____ , 20____ .

Notary Public

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University Building Official
230 Sterrett Drive, 30A (0529)
vtubo-g@gmail.com

Rev. 05/25

HECO-13.1

CERTIFICATE OF COMPLETION BY ARCHITECT/ENGINEER

TO: University Building Official
230 Sterrett Drive, Suite 30A
Blacksburg, VA 24061

Date: _____

PROJECT TITLE: _____

PROJECT #: _____

INSTITUTION/AGENCY: _____

ADDRESS: _____

In accordance with the requirements of the Contract Between Owner and Architect/Engineer for Professional Services (CO-3) or the Contract Between Owner and Project Manager and based upon the knowledge gained in the performance of the services required in said Agreement, the undersigned hereby states that the above-named project was fully completed in accordance with the requirements of the Contract Documents on _____.

All applicable tests, certificates and regulatory inspections required by the 2021 Edition of the Virginia Uniform Statewide Building Code, which was the basis of the design of the project, have been performed and the Owner has been provided with a copy of each report. A copy of the Final Report of Structural & Special Inspections (HECO-13.1b) is attached to this certificate. All deficiencies noted during the inspection have been corrected or resolved.

The accessibility standards required by Chapter 4 of the applicable A/E manual, as revised, have been met.

The Owner has been provided with a copy of all warranties and guarantees, including the starting date(s) of all warranties and guarantees, written and unwritten, required by the Contract Documents.

ARCHITECT OF RECORD

CO. NAME:_____

PHONE: _____

Virginia RDP Seal

_____

(SEAL & SIGNATURE) *(DATE)*

Attachments:
Final Report of Structural & Special Inspections (HECO-13.1b)

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University Building Official
230 Sterrett Drive, 30A (0529)
vtubo-g@gmail.com

HECO-13.1A

Rev. 02/25

CERTIFICATE OF SUBSTANTIAL COMPLETION BY ARCHITECT/ENGINEER

TO: University Building Official
230 Sterrett Drive, Suite 30A
Blacksburg, VA 24061

Date: _____

PROJECT TITLE: _____

PROJECT #: _____

INSTITUTION/AGENCY: _____

ADDRESS: _____

In accordance with the requirements of the Agreement between the Owner and the Architect / Engineer and based upon the knowledge gained in the performance of the architectural / engineering services provided in said Agreement and the reports of the Owner's Inspection and Testing entities, the undersigned Architect / Engineer states that the following portions of the project named above are substantially complete in accordance with the requirements of the Contract Documents and are recommended for occupancy: (Indicate portions which are recommended for occupancy)

All applicable tests, certificates and regulatory inspections required by the 2021 edition of the Virginia Uniform Statewide Building Code, which was the basis of the design of the project, have been performed with respect to the substantially completed portions of the project and the Owner has been provided with a copy of each report, except for the following:

The handicapped standards required by Chapter 4 of the applicable A/E Manual, as revised, have been met. A copy of the Final Report of Structural & Special Inspections, Form HECO-13.1b, is attached to this certificate.

A tentative list of unfinished Work and defective Work, referred to as the "punch list", is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of CONTRACTOR to complete all the Work in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by CONTRACTOR within _____ days of the above date of Substantial Completion.

Submitted By:

Firm Name _____ Date: _____

Signature: _____ Printed Name/Title _____

Attachments:

Final Report of Structural & Special Inspections (HECO-13.1B)
Checklist for Beneficial Occupancy (HECO-13.3B)
Punch list containing page 1 through _____.

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University Building Official
230 Sterrett Drive, 30A (0529)
vtubo-g@gmail.com

HECO13.1B

Rev. 05/25

FINAL REPORT OF STRUCTURAL AND SPECIAL INSPECTIONS

PROJECT TITLE: _____

PROJECT #: _____

Institution/Agency: _____

A/E OF RECORD: _____

To the best of my information, knowledge, and belief, the Structural and Special Inspections required for this project, and itemized in the Form HECO-6b, Special Inspections listing attached to the Form HECO-6a, Statement of Structural and Special Inspections, submitted for permit have been completed.

The discrepancies that remain outstanding since the last interim report dated: _____, are corrected or have been resolved as follows:

Attach continuation sheet(s) if required to complete the description of corrections or resolution of deviations.

Respectfully Submitted,

STRUCTURAL ENGINEER OF RECORD	A/E OF RECORD	SMOKE CONTROL RDP
CO. NAME: _____	CO. NAME _____	CO. NAME _____
PHONE: _____	PHONE: _____	PHONE: _____
Virginia RDP Seal	Virginia RDP Seal	Virginia RDP Seal
_____	_____	_____
(SEAL & SIGNATURE) *(DATE)*	*(SEAL & SIGNATURE)* *(DATE)*	*(SEAL & SIGNATURE)* *(DATE)*

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University Building Official
230 Sterrett Drive, 30A (0529)
vtubo-g@gmail.com

HECO-13.2

Rev. 02/25

CERTIFICATE OF COMPLETION BY CONTRACTOR

TO: University Building Official
230 Sterrett Drive, Suite 30A
Blacksburg, VA 24061

Date: _____

PROJECT TITLE: _____

PROJECT #: _____

CONTRACTOR NAME: _____

CONTRACTOR LICENSE #: _____

In accordance with the requirements of the Contract between Owner and Contractor (Form CO-9), the undersigned Contractor hereby states that the above-named project has been fully completed in accordance with the requirements of the Contract Documents as modified by approved change orders.

All applicable tests, certificates and regulatory inspections required by the Virginia Uniform Statewide Building Code and the Contract Documents have been performed with respect to the completed project and the Owner has been provided with a copy of each report.

As-built marked up prints of the completed project have been provided to the Architect/Engineer as required by the Contract Documents.

The Owner has been provided with a copy of all warranties and guarantees, including the starting date(s) of all warranties and guarantees, written and unwritten, required by the Contract Documents.

All training, operating instructions and maintenance manuals required by the Contract Documents have been provided to the Owner.

Submitted By:

Contractor Signature:_____ Date: _____

Printed Name/Title _____

CC: Project Manager
A/E

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University Building Official
230 Sterrett Drive, 30A (0529)
vtubo-g@gmail.com

HECO-13.2A

Rev. 02/25

CERTIFICATE OF PARTIAL OR SUBSTANTIAL COMPLETION BY CONTRACTOR

TO: University Building Official
230 Sterrett Drive, Suite 30A
Blacksburg, VA 24061

Date: _____

PROJECT TITLE: _____

PROJECT #: _____

CONTRACTOR NAME: _____

CONTRACTOR LICENSE #: _____

In accordance with the requirements of the Agreement between the Owner and the Contractor, the undersigned Contractor hereby states that portions of the above-named project are substantially completed in accordance with the requirements of the Contract Documents as modified by approved change orders. Those portions of the project now substantially complete are: (list or describe)

All applicable tests, certificates and regulatory inspections required by the Virginia Uniform Statewide Building Code and the Contract Documents have been performed with respect to the substantially completed portions of the project and the Owner has been provided with a copy of each report. As-built marked up prints of the substantially completed portions of the project have been provided to the Architect/Engineer as required by the Contract Documents.

The Owner has been provided with a copy of all warranties and guarantees, including the starting date(s) of all warranties and guarantees, written and unwritten, required by the Contract Documents with respect to the completed portions of the project, except as follows:

All training, operating instructions and maintenance manuals required by the Contract Documents have been provided to the Owner, except as follows: (list or describe)

This certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of CONTRACTOR's obligation to complete the Work in accordance with the Contract Documents.

Submitted By:

Contractor Signature:_____ Date: _____

Printed Name/Title _____

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DOCUMENT 000115 - LIST OF DRAWING SHEETS

PART 1 - GENERAL

1.1 LIST OF DRAWINGS

A. List of Drawings: Drawings that will be enumerated in the Contract between Owner and Contractor as part of the Contract Documents are the following Drawings and other drawings of type indicated, as modified by subsequent Addenda and Modifications:

GENERAL
GI001 COVER SHEET
GI002 CODE REVIEW SHEET
GI003 LIFE SAFETY PLAN

CIVIL
C0.0 COVER SHEET
C0.1 GENERAL NOTES
C0.2 GENERAL DETAILS
C1.0 EXISTING CONDITIONS AND DEMOLITION PLAN
C2.0 EROSION AND SEDIMENT CONTROL NOTES
C2.1 EROSION AND SEDIMENT CONTROL DETAILS
C2.2 EROSION & SEDIMENT CONTROL – PHASE 1
C2.3 EROSION & SEDIMENT CONTROL – PHASE 2
C3.0 SITE AND UTILITY LAYOUT
C3.1 ADDITIVE BID ITEM SITE AND UTILITY LAYOUT
C3.2 FIRE MARSHAL PLAN
C4.0 GRADING & DRAINAGE PLAN
C4.1 STORMWATER MANAGEMENT PLAN
C5.0 UTILITY PROFILES
L1.0 PLANTING PLAN

STRUCTURAL
S001 GENERAL NOTES
S002 STRUCTURAL LEGEND AND ABBREVIATIONS
S101 FOUNDATION PLAN AND ADDITIVE BID ITEM 1 FOUNDATION PLAN
S201 FOUNDATION SECTIONS AND DETAILS

ARCHITECTURAL
A-001 ARCHITECTURAL LEGEND, NOTES & ABBREVIATIONS
AE101 FLOOR PLAN AND ROOF PLAN
AE102 REFLECTED CEILING PLAN
AE201 EXTERIOR ELEVATIONS
AE202 EXTERIOR ELEVATIONS, FINISH SCHEDULE & SIGNAGE DETAILS
AE301 BUILDING SECTIONS
AE302 DETAILS

AE401 ENLARGED PLUMBING PLAN
AE501 PARTITION TYPES AND DETAILS
AE601 DOOR SCHEDULE AND DETAILS
AE602 WINDOW DETAILS
AE701 CASEWORK ELEVATIONS, SECTIONS & DETAILS

PLUMBING
P000 LEGENDS, ABBREVIATIONS & GENERAL NOTES
P101 FLOOR PLAN
P102 FLOOR PLAN
P501 DETAILS
P502 DETAILS
P601 RISERS
P701 SCHEDULES

MECHANICAL
M000 LEGENDS, ABBREVIATIONS & GENERAL NOTES
M101 FLOOR PLAN
M501 DETAILS
M601 SCHEDULES
M801 CONTROLS

ELECTRICAL
E000 LEGENDS, ABBREVIATIONS & GENERAL NOTES
E001 SITE PLAN – ELECTRICAL
E101 FLOOR PLAN – LIGHTING
E102 FLOOR PLAN – POWER
E103 FLOOR PLAN – SPECIAL SYSTEMS
E501 DETAILS
E502 DETAILS
E503 LIGHTNING PROTECTION PLAN
E601 FA RISER AND MATRIX
E701 SCHEDULES & RISERS

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 000115

VIRGINIA TECH

2021 Code Version

STATEMENT OF VUSBC SPECIAL INSPECTIONS & STRUCTURAL OBSERVATIONS

HECO-6a

University Building Official
Sterrett Facilities Complex, 30A
VTUBO-g@vt.edu

DATE:

INSTITUTION/AGENCY:

PROJECT TITLE:

UBO NUMBER:

PROJECT MANAGER

The following firms are designated to perform the Special Inspections required herein. The firm has the experience, qualifications, certifications and/or licenses required to perform the functions indicated.

OWNER'S TESTING AND INSPECTION SERVICE

OWNER'S TEST LAB	SPECIAL INSPECTION RDP	SMOKE CONTROL INSPECTION & TESTING RDP
Co. Name	Co. Name	Co. Name
Phone:	Phone:	Phone:
Virginia RDP Seal	Virginia RDP Seal	Virginia RDP Seal
(Seal & Signature) *(Date)*	*(Seal & Signature)* *(Date)*	*(Seal & Signature)* *(Date)*

Inspection and/or Testing responsibilities are indicated on the attached List of Special Inspections, Form HECO-6b. Copies of all test data and reports shall be provided to the Architect/Engineer of Record and to the Owner's Project Manager on a timely basis. The Contractor and UBO shall be notified of all deficiencies and discrepancies in a timely manner so that corrective action can be taken.

PROFESSIONAL OVERSIGHT AND CERTIFICATION

STRUCTURAL ENGINEER OF RECORD	A/E of RECORD	SMOKE CONTROL RDP
Co. Name BENNETT & PLESS	Co. Name	Co. Name
Phone: 865-321-8634	Phone:	Phone:
COMMONWEALTH OF VIRGINIA CRAIG M. FAVOR Lic. No. 39775 PROFESSIONAL ENGINEER Craig M Favor Digitally signed by Craig M Favor Date: 2021.08.19 16:42:31-04'00'	Virginia RDP Seal	Virginia RDP Seal
(Seal & *)*	*(Seal & Signature)* *(Date)*	*(Seal & Signature)* *(Date)*

CODE OFFICIAL'S ACCEPTANCE

☐ Acceptable as submitted

☐ Acceptable as marked

By: _____

University Building Official *(Date)*

Attachment: HECO-6b List of Special Inspections

2021 SPECIAL INSPECTIONS

University Building Official
Sterrett Facilities Complex, 30A
vtubo-g@vt.edu

Project Title:

Rev. 06/26 **Project Code:**

HECO 6b

MATERIAL / ACTIVITY	TYPE OF INSPECTION (RDP add lines as needed to identify other required items)	REQUIRED	REFERENCE	INSPECTION / TEST BY: SPECIAL INSPECTOR/ TEST LAB	RDP OF RECORD	OTHER
CONTRACTOR RESPONSIBILITY *(see Note #7)*						
Structure	Special Inspections for Wind Resistance and/or Seismic resistance.	NO	VCC 1704.6	Continuous		
STRUCTURAL OBSERVATIONS *(see Note #6)*						
Structure	Structural observations as identified by the structural observer in a written statement.	NO	VCC 1704.6	See Note #6, supplemental forms req'd.		
FOUNDATIONS						
Soil	Verify material below shallow foundations are adequate to achieve the design bearing capacity.	YES	VCC T1705.6 #1	Periodic		
Soil	Verify excavation is extended to proper depth and has reached proper material.		VCC T1705.6 #2	Periodic		
Soil	Perform classification and testing of compacted fill materials.		VCC T1705.6 #3	Periodic		
Soil	During fill placement verify conformance to geotechnical report.		VCC T1705.6 #4	Continuous		
Soil	Prior to fill, inspect subgrade to verify prepared properly.		VCC T1705.6 #5	Periodic		
Helical Pile	Install equipment, pile dimensions, tip elevations, final depth, final installation torque and other pertinent installation data.	NO	VCC 1705.9	Continuous		
Deep Foundations	Reasonable doubt as to the structural integrity.		VCC 1705.10	Continuous	Note #8	
Deep Foundations	Verify element materials, sizes and lengths.		VCC T1705.7 #1	Continuous		
Deep Foundaitons	Determine capacities of test elements and conduct additional load tests.		VCC T1705.7 #2	Continuous		
Deep Foundations	Inspect driving operations and maintain complete and accurate records.		VCC T1705.7 #3	Continuous		
Deep Foundations	Record placement and install criteria.		VCC T1705.7 #4	Continuous		
Deep Foundations	For steel elements, perform special inspections per 1705.2		VCC T1705.7 #5	Continuous		
Deep Foundations	For concrete elements, perform special inspections per 1705.3		VCC T1705.7 #6	Continuous		
Deep Foundations	For speciality elements, perform additional inspections per the RDP.		VCC T1705.7 #7	Continuous		
Cast Deep Fnds	Inspect drilling operations and maintain complete and accurate records.		VCC T1705.8 #1	Continuous		
Cast Deep Fnds	Record placement and install criteria.		VCC T1705.8 #2	Continuous		
Cast Deep Fnds	For concrete elements, perform special inspections per 1705.3		VCC T1705.8 #3	Continuous		

Project Title:

Rev. 06/26 **Project Code:** HECO 6b

MATERIAL / ACTIVITY	TYPE OF INSPECTION (RDP add lines as needed to identify other required items)	REQUIRED	REFERENCE	INSPECTION / TEST BY: SPECIAL INSPECTOR/ TEST LAB	RDP OF RECORD	OTHER
CONCRETE CONSTRUCTION						
Concrete	Reinforcement, including prestressing tendons, verfiy placement.	YES	VCC T1705.3 #1	Periodic		
Concrete	Reinforcing bar welding.	NO	VCC T1705.3 #2	Continuous / Periodic		
Concrete	Inspect anchors cast in concrete	YES	VCC T1705.3 #3	Periodic		
Concrete	Inspect anchors post-installed.		VCC T1705.3 #4	YES Continuous / Periodic		
Concrete	Verify use of required design mix		VCC T1705.3 #5	Periodic		
Concrete	Concrete test specimens		VCC T1705.3 #6	Continuous		
Concrete	Concrete and shotcrete placement for proper application.		VCC T1705.3 #7	Continuous		
Concrete	Verify maintenance of specified curing temperature and techniques.	↓	VCC T1705.3 #8	Periodic		
Concrete	Prestressed concrete application of forces and grouting.	NO	VCC T1705.3 #9	Continuous		
Concrete	Precast concrete member erection.		VCC T1705.3 #10	Periodic		
Concrete	Precast concrete diaphragm connections or reinforcement at joints classified MDE or HDE.		VCC T1705.3 #11	Continuous		
Concrete	Tolerances of precast concrete diaphragm connections.		VCC T1705.3 #12	Periodic		
Concrete	Verify in-situ concrete strength.		VCC T1705.3 #13	Periodic		
Concrete	Inspect formwork.	↓	VCC T1705.3 #14	Periodic		
STEEL CONSTRUCTION						
Fabricator	Quality Control Inspection Of Shop	YES	VCC 1704.2.5	Periodic	Note #2	
Steel	Welding		AISC 360-16 N5.1	Periodic		
Steel	High Strength Bolting	↓	AISC 360-16 N5.1	Periodic		
Steel	Galvanized structural steel	NO	AISC 360-16 N5.1	Periodic		
Decking	Cold Form Steel Decking		VCC 1705.2.2	Periodic		
Joist	1a open web joist and joist girders end connections.		VCC T1705.2.3	Periodic	Note #2	
Joist	1b1 open web joist and joist girder standard bridging.		VCC T1705.2.3	Periodic	Note #2	
Joist	1b2 open web joist and joist girder other bridging.		VCC T1705.2.3	Periodic	Note #2	
Trusses	Cold form steel trusses, span >60 feet	↓	VCC 1705.2.4	Periodic	Note #2	

Project Title:

Rev. 06/26 **Project Code:** HECO 6b

MATERIAL / ACTIVITY	TYPE OF INSPECTION (RDP add lines as needed to identify other required items)	REQUIRED	REFERENCE	INSPECTION / TEST BY: RDP OF RECORD		
MASONRY CONSTRUCTION				*Level 1*	*Level 2*	*Level 3*
Indicate Quality Assurance Level (1, 2, 3)			*TMS 402 3.1*			
Masonry - Verify	Verification of compliance of submittals.	NO	TMS 602 1.6 Table 3	Note #2	Note #2	Note #2
Masonry - Verify	Verify f'm and f'AAC.		TMS 602 1.6 Table 3		Note #2	Note #2
Masonry - Verify	Verify slump flow and Visual Stability Index for self consolidating grout.		TMS 602 1.6 Table 3		Note #2	Note #2
Masonry - Verify	Verfiy f'm and f'AAC, for every 5,000 sq.ft.		TMS 602 1.6 Table 3			Note #2
Masonry - Verify	Verify proportions as delivered to the project site.		TMS 602 1.6 Table 3			Note #2
Masonry - Inspect	1a Proportions of site-prepared mortar.		TMS 602 1.6 Table 4		Periodic	Periodic
Masonry - Inspect	1b Grade and size of prestressing tendons and anchorage.		TMS 602 1.6 Table 4		Periodic	Periodic
Masonry - Inspect	1c Grade, type and size of reinforcement, connectors, anchor bolts, and prestresssing tendons and anchorage.		TMS 602 1.6 Table 4		Periodic	Periodic
Masonry - Inspect	1d Prestressing technique		TMS 602 1.6 Table 4		Periodic	Periodic
Masonry - Inspect	1e Properties of thin-bed mortar for AAC masonry		TMS 602 1.6 Table 4		Continuous / Periodic	Continuous
Masonry - Inspect	1f sample panel construction		TMS 602 1.6 Table 4		Periodic	Continuous
Masonry - Inspect	2a Grout Space		TMS 602 1.6 Table 4		Periodic	Continuous
Masonry - Inspect	2b Placement of prestressing tendons and anchorages		TMS 602 1.6 Table 4		Periodic	Periodic
Masonry - Inspect	2c Placement of reinforcement, connectors, and anchor bolts		TMS 602 1.6 Table 4		Periodic	Continuous
Masonry - Inspect	2d Proportions of site-prepared grout and prestressing grout for bonded tendons.		TMS 602 1.6 Table 4		Periodic	Periodic
Masonry - Inspect	3a Materials and procedures with the approved submittals		TMS 602 1.6 Table 4		Periodic	Periodic
Masonry - Inspect	3b Placement of masonry units and mortar joint construction		TMS 602 1.6 Table 4		Periodic	Periodic
Masonry - Inspect	3c Size and location of structural members		TMS 602 1.6 Table 4		Periodic	Periodic
Masonry - Inspect	3d Type, size, and location of anchors, including other details of anchorage of masonry to structural members, frames, or other construction.		TMS 602 1.6 Table 4		Periodic	Continuous
Masonry - Inspect	3e Welding of reinforcement		TMS 602 1.6 Table 4		Continuous	Continuous
Masonry - Inspect	3f Preparation, construction, and protection of masonry during cold or hot weather (<40F or >90F)		TMS 602 1.6 Table 4		Periodic	Periodic
Masonry - Inspect	3g Application and measurement of prestressing force.		TMS 602 1.6 Table 4		Continuous	Continuous
Masonry - Inspect	3h Placement of grout and prestressing grout for bonded tendons is in compliance.		TMS 602 1.6 Table 4		Continuous	Continuous
Masonry - Inspect	3i Placement of AAC masonry units and construction of thin-bed mortor joints.		TMS 602 1.6 Table 4		Continuous / Periodic	Continuous
Masonry - Inspect	4 Observe preparation of grout specimens, mortar specimens, and/or prisms.		TMS 602 1.6 Table 4		Periodic	Continuous
Glass Unit	Glass unit masonry and masonry veneer in Risk Category IV		VCC 1705.4.1			
Vertical Masonry	Vertical masonry foundation elements		VCC 1705.4.2			

Project Title:

Rev. 06/26 **Project Code:** HECO 6b

MATERIAL / ACTIVITY	TYPE OF INSPECTION (RDP add lines as needed to identify other required items)	REQUIRED	REFERENCE	INSPECTION / TEST BY: SPECIAL INSPECTOR/ TEST LAB	RDP OF RECORD	OTHER
WOOD CONSTRUCTION						
Wood	Wood material labeling	NO	VCC 1703.5	Periodic	Note #2	
Wood	Quality Control Inspection Of Shop Fabrication		VCC 1704.2.5	Periodic	Note #2	
Wood	High-load Diaghragms		VCC 1705.5.1	Periodic		
Wood-Trusses	Metal-plate counnected wood trusses, span >60 feet		VCC 1705.5.2	Periodic	Note #2	
Mass Timber	Anchorage and connections to timber deep foundation systems		VCC T1705.5.3	Periodic		
Mass Timber	Inspect erection of mass timber construction		VCC T1705.5.3	Periodic		
Mass Timber	Inspect connections where installation methods are required to meet design loads - Threaded connections		VCC T1705.5.3	Periodic		
Mass Timber	Inspect connections where installation methods are required to meet design loads - adhesive anchors - sustained tension loads		VCC T1705.5.3	Continuous		
Mass Timber	Inspect connections where installation methods are required to meet design loads - other adhesive anchors		VCC T1705.5.3	Periodic		
Mass Timber	Inspect connections where installation methods are required to meet design loads - bolted connections		VCC T1705.5.3	Periodic		
Mass Timber	Inspect connections where installation methods are required to meet design loads - concealed connections.		VCC T1705.5.3	Periodic		
Sealing	Sealants or adhesives where required by section 703.7		VCC 1705.20	Periodic		
WIND FORCE RESISTANCE *Wind exposure category B, where V >= 150 mph or Wind exposure category C or D, where V >= 140 mph*						
Wood	Field gluing, nailing, bolting, anchoring, and other fastening of MWFRS, including wood shear walls, wood diaphragms, drag struts, braces, and hold downs.	NO	VCC 1705.12.1	Continuous / Periodic		
Cold Formed Steel	Welding, screw attachment of MWFRS, including shear walls, braces, diaphrams, collectors, and hold downs.		VCC 1705.12.2	Periodic		
Components	Fastening of the roof covering, roof deck, roof framing connections, exterior wall covering, and wall connections to roof and floor diaphragms and framing.		VCC 1705.12.3	Periodic		

Project Title:

Rev. 06/26 **Project Code:** HECO 6b

MATERIAL / ACTIVITY	TYPE OF INSPECTION (RDP add lines as needed to identify other required items)	REQUIRED	REFERENCE	INSPECTION / TEST BY: SPECIAL INSPECTOR/ TEST LAB	RDP OF RECORD	OTHER
SEISMIC RESISTANCE						
Steel	Steel in SFRS for SDC B,C,D,E, or F.	NO	VCC 1705.13.1.1	Periodic		
Steel	Steel in SFRS for SDC B,C,D,E, or F other than above		VCC 1705.13.1.2	Periodic		
Wood	Wood in SFRS for SDC C, D, E, or F		VCC 1705.13.2	Continuous / Periodic		
Cold Formed Steel	Cold Formed Steel for SDC C, D, E, or F		VCC 1705.13.3	Periodic		
Designated systems	For SDC C,D,E, or F designated seismic systems requiring qualificaiton in accordance with 13.2.2 of ASCE 7 shall be inspected to verify label, anchorage and mounting conform to the certificate of compliance.		VCC 1705.13.4	Periodic		
Architectural	Inspection is required for erection and fastening of cladding, interior and exterior nonbearing walls and interior/ exterior veneer in SDC D, E, F.		VCC 1705.13.5	Periodic		
Access Floors	Anchorage of access floors in SDC D, E, or F.		VCC 1705.13.5.1	Periodic		
MEP components	Inspection of anchorage depending on application, SDC C, D, E, or F.		VCC 1705.13.6	Periodic		
Storage Racks	Materials used, to verify compliance with one or more of the material test reports in accordance with construction documents. SDC D, E, or F.		VCC T1705.13.7 #1	Periodic		
Storage Racks	Fabricated storage rack elements SDC D, E, or F.		VCC T1705.13.7 #2	Periodic		
Storage Racks	Storage rack anchorage installation.		VCC T1705.13.7 #3	Periodic		
Storage Racks	Completed system, to indicate compliance with construction docs.		VCC T1705.13.7 #4	Periodic		
Isolation Systems	Systems in seismically isolated structures in SDC B, C, D, E or F		VCC 1705.13.8	Periodic		
Cold Formed Steel	Cold Formed Steel special bolted moment frames SDC D, E, F		VCC 1705.13.9	Periodic		
Testing	Structural Steel SDC B, C, D, E, F		VCC 1705.14.1	Periodic		
Testing	Nonstructural Components SDC B, C, D, E, F		VCC 1705.14.2		Note #2	
Testing	Designated Seismic Systems SDC C, D, E, F		VCC 1705.14.3		Note #2	
Testing	Seismic Isolation Systems SDC B, C, D, E, F		VCC 1705.14.4	Periodic		

Project Title:

Rev. 06/26 **Project Code:** HECO 6b

MATERIAL / ACTIVITY	TYPE OF INSPECTION (RDP add lines as needed to identify other required items)	REQUIRED	REFERENCE	INSPECTION / TEST BY: SPECIAL INSPECTOR/ TEST LAB	RDP OF RECORD	OTHER
FIREPROOFING *(See Note #9)*						
Spray-on	Physical and Visual Tests	NO	VCC 1705.15.1	Continuous		
Spray-on	Surface Conditions	↓	VCC 1705.15.2	Continuous		
Spray-on	Application	↓	VCC 1705.15.3	Continuous		
Spray-on	Thickness	↓	VCC 1705.15.4	Continuous		
Spray-on	Density	↓	VCC 1705.15.5	Continuous		
Spray-on	Bond Strength	↓	VCC 1705.15.6	Continuous		
Mastic/Intumescent	Mastic and Inumescent Fire-Resistant Coatings	↓	VCC 1705.16	Continuous		
EXTERIOR INSULATION & FINISH SYSTEMS (EIFS)						
Coating	Water-Resistive Barrier Coating	NO	VCC 1705.17.1	Continuous		
Materials	Manufacturer's Data	↓	Specifications	Continuous		
Preparation	Condition Of Substrate	↓	Specifications	Continuous		
Application	Methods, Proportions & Thickness Of Installation	↓	Specifications	Continuous		
SMOKE CONTROL *(see note #5)*				SMOKE CONTROL		
Testing	Testing for Smoke Control	NO	VCC 1705.19	Continuous		
Ducts	Device Location And Air Duct Leakage	↓	Specifications	Continuous		
System	Pressure Difference, Flow Measurements & Detection Testing	↓	Specifications	Continuous		
Controls	Control Verification, Activation Sequence	↓	Specifications	Continuous		

NOTES

1. Fabricator, supplier, ready-mixed plant or other production plant shall provide certificates from an approved independent inspection, testing or quality assurance agency attesting that the plant meets at least one of the following criteria:
   a. The plant is a certified production plant meeting the quality assurance standards of a recognized national standards organization for that product.
   b. The plant maintains an agreement with an independent inspection or quality assurance agency to conduct periodic in-plant quality assurance inspections. The frequency of these inspections shall not be less than one every six months.
   c. The plant has an in-shop quality assurance inspection program by an independent testing or quality assurance agency for the work/product to be provided on this project.
2. RDP of Record shall review fabricator/supplier/producer certificates for conformance or compliance with appropriate standards of practice and quality assurance.
3. Contractor/supplier shall submit manufacturer's certificates of compliance for the materials/products as required by VCC 1704.5.
4. A/E shall review records and test results of all special inspections for conformance with requirements.
5. Special Inspection firm shall have expertise in fire protection engineering, mechanical engineering, and certification as an air balancer. The special inspector listed on the cover page and the Agency are responsible for verifying that the inspector(s) for smoke control is qualified as required by VCC 1705.19.2.
6. In addition to this form, the supplemental form HECO 6a-SO "Statement of Structural Observations" will be submitted to the UBO identifying the frequency and extent of intended structural observations (VCC 1704.6). HECO 6a-SO must be completed jointly by the structural observer RDP, EOR, and VT PM prior to submission to the UBO. Additionally, form HECO 13.1d "Final Report of Structural Observations" must be submitted at the completion of the project.
7. VCC 1704.3 requires special inspections for seismic or wind resistance. This statement of inspections shall identify systems or components that are subject to such special inspections or tests in accordance with VCC 1704.3.2 and 1704.3.3. The contractor shall complete, sign and submit the written statement of responsibility in HECO-6c prior to the commencement of work in acknowledgement of awareness of the special inspections as required by VCC 1704.4.
8. The RDP of Record shall determine the frequency of the special inspections (continuous or periodic) in accordance with the adopted codes and standards and shall be noted accordingly on this form.
9. Inspections for sprayed fire-resistant materials, mastic, and intumescent fire-resistant coatings shall be performed during construction. An additional visual inspection shall be performed after the rough installation and where applicable, prior to the concealment of electrical, automatic sprinkler, mechanical and plumbing systems.

SECTION 010200 - GENERAL SITEWORK REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the Contract Documents apply to the work of this Section.

1.2 SITEWORK LAYOUT

A. Monuments and Benchmarks

1. Maintain all monuments, property corners, benchmarks and other reference points.
2. If these are disturbed or destroyed during construction operations, have them replaced by a surveyor licensed in the Commonwealth of Virginia. This replacement shall be at no additional expense to the Contract.

B. Laying out the Work.

1. Locate all existing benchmarks and other reference points.
2. Protect these points throughout construction.
3. Layout work utilizing these reference points.

C. Record Drawings

1. Maintain a record drawings in accordance with the latest versions of Virginia Tech's Construction and Professional Services Manual and the Virginia Tech Design and Construction Standards Manual.

1.3 EASEMENTS

A. Verify the acquisition of all off-site easements in writing from the University's project manager prior to the start of off-site construction.

B. Restore all off-site easements to the condition existing prior to the start of work.

1.4 MAINTENANCE OF TRAFFIC

A. Maintain vehicular and pedestrian traffic across the frontage of this project. Comply with all applicable safety requirements.

B. Contractor shall provide traffic control measures. All control measures should follow the guidelines and requirements of the VDOT Virginia Work Area Protection Manual, latest edition.

C. Contractor shall maintain emergency vehicle access to all firefighting elements (fire hydrants, PIV, FDC, etc.) and existing buildings at all times. Contractor shall prepare sequencing plans and review work with local fire marshals with regard to maintaining fire truck access where required.

1.5 CORRELATION OF CONSTRUCTION DOCUMENTS

A. Review construction documents thoroughly prior to the start of construction.

B. Report any conflict or discrepancy discovered in the Construction Documents to the Architect prior to the start of construction.

C. Report any conflict or discrepancy discovered between the Construction Documents and state and local governmental regulations to the Architect prior to the start of construction.

1.6 PROJECT CONDITIONS

A. The conditions existing at the time of inspection for bidding purposes will be maintained by the Owner to the extent practical. However, minor variations may occur due to natural occurrences prior to the start of clearing work.

B. The location of existing underground utilities indicated is approximate only. Field locate all existing underground utilities in the area of work, regardless of whether or not they are indicated. Call “Miss Utility” prior to the start of demolition work for assistance in the location of existing underground utilities.

C. Should charted, uncharted or incorrectly charted utilities be encountered during demolition, contact the Architect immediately for instructions. Cooperate with Virginia Tech Electric Services (VTES) and utility companies to keep services and facilities in operation.

PART 2 - PRODUCTS (Not Applicable)
PART 3 - EXECUTION

3.1 PROJECT CLEAN UP

A. Clean site as construction progresses. Don't allow trash or other waste materials to accumulate.

B. Prior to requesting the punch-list inspection, clean the site to the following requirements:

1. Power wash all walks and pavements.
2. The remainder of the site shall be broom clean.
3. Remove all trash and debris.

3.2 EXISTING FACILITIES

A. Preserve existing signs, markers, guardrails, fences/gates and other amenities in their original condition unless written permission is obtained for their removal and replacement.

B. Replace damaged items at no additional cost to the Contract.

END OF SECTION 010200

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work restrictions.
4. Specification and Drawing conventions.

1.2 PROJECT INFORMATION

A. Project Identification: Forest Harvesting Lab Replacement Building, Virginia Tech Project Code WO# 26-819490.

1. Project Location: Inventive Lane, Virginia Tech campus, Blacksburg, VA.

B. Owner: Virginia Tech, Blacksburg, Virginia.

1. Owner's Representative: Jason Paljug, Supervisory Non-Capital Construction Project Manager, Virginia Tech Non-Capital Construction, 230 Sterrett Drive, 41E, Blacksburg, VA 24061, jlpaljug@vt.edu.

C. Architect: Clark Nexsen, A JMT Company, 213 S Jefferson Street, STE 1011, Roanoke, VA 24011.

1. Architect's Representative: John Wissinger, Principal, John.Wissinger@clarknexsen.com.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. Construction of a single-story pre-engineered metal building of approximately 3,750 square feet, with associated mechanical and electrical equipment and sitework.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.4 CONTRACTOR'S USE OF SITE AND PREMISES

A. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not

disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways and entrances serving adjacent premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

B. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.5 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to between 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

1. Weekend Hours: Work on Saturdays is permitted subject to Owner’s prior approval. Request Owner’s approval not less than one day in advance of Saturday work. Limit Saturday work to between 8:00 a.m. to 5:00 p.m.

C. 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 for temporary utility services according to requirements indicated:

1. Notify Owner not less than two business days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than two business days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

E. Smoking and Controlled Substance Restrictions: Use of tobacco products , alcoholic beverages, and other controlled substances on Owner's property is not permitted.

1.6 SPECIFICATION AND DRAWING CONVENTIONS

A. 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. Imperative mood and streamlined language are generally used in the

Specifications. 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.

2. 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.
3. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

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: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. 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.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

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SECTION 012300 – ADDITIVE BID ITEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for additive bid items.

1.2 DEFINITIONS

A. Additive Bid Item: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Additive bid items described in this Section are part of the Work only if enumerated in the Contract for Construction.
2. The cost for each additive bid item is the net addition to the Contract Sum to incorporate additive bid items into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the additive bid item into Project.

1. Include, as part of each additive bid item, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of additive bid item.

B. Execute accepted additive bid items under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Additive Bit Items" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each additive bid item.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ADDITIVE BID ITEMS

A. Additive Bid Item 1: Storage Lean-To.

1. Base Bid: Base Bid: Storage lean-to is not provided.
2. Additive Bid Item: Provide exterior storage lean-to structure as indicated on the Drawings.

B. Additive Bid Item 2 Lightning Protection System.

1. Base Bid: Lightning protection system is not provided.
2. Additive Bid Item: Provide lightning protection system as indicated on the Drawings and as specified in Section 264113 “Lightning Protection for Structures."

END OF SECTION 012300

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. RFIs.
3. Project meetings.

1.2 DEFINITIONS

A. RFI: Request for Information. Request from Owner, A/E, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 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 required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities 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.

1.4 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. A/E will return without response those RFIs submitted to A/E by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Owner name.
3. Owner's Project number.
4. Name of A/E.
5. A/E's Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Price, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to A/E .

1. Attachments shall be electronic files in PDF format.

D. Action: A/E will review each RFI, determine action required, and respond. Allow three days for A/E's response for each RFI. RFIs received by A/E after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.

b. Requests for approval of substitutions.
c. Requests for approval of Contractor's means and methods.
d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Price.
f. Requests for interpretation of A/E's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. 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 by A/E of additional information.
3. A/E's action on RFIs that may result in a change to the Contract Time or the Contract Price may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Price, notify A/E in writing within 5 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of A/E.
4. RFI number, including RFIs that were returned without action or withdrawn.
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.

F. 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 three days if Contractor disagrees with response.

1.5 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and A/E of scheduled meeting dates and times a minimum of seven days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and A/E, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and A/E, but no later than 15 days after Notice to Proceed.

1. Attendees: Authorized representatives of Owner, A/E, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; 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. Responsibilities and personnel assignments.
    b. Tentative construction schedule.
    c. Phasing.
    d. Critical work sequencing and long lead items.
    e. Designation of key personnel and their duties.
    f. Lines of communications.
    g. Procedures for processing field decisions and Change Orders.
    h. Procedures for RFIs.
    i. Procedures for testing and inspecting.
    j. Procedures for processing Certificate for Payment.
    k. Distribution of the Contract Documents.
    l. Submittal procedures.
    m. Preparation of Record Documents.
    n. Use of the premises.
    o. Work restrictions.
    p. Working hours.
    q. Owner's occupancy requirements.
    r. Responsibility for temporary facilities and controls.
    s. Procedures for moisture and mold control.
    t. Procedures for disruptions and shutdowns.
    u. Construction waste management and recycling.
    v. Parking availability.
    w. Office, work, and storage areas.
    x. Equipment deliveries and priorities.
    y. First aid.
    z. Security.
    aa. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: 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 Owner and A/E of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

    a. Contract Documents.
    b. Options.
    c. Related RFIs.
    d. Related Change Orders.
    e. Purchases.
    f. Deliveries.
    g. Submittals.
    h. Review of mockups.
    i. Possible conflicts.
    j. Compatibility requirements.
    k. Time schedules.
    l. Weather limitations.
    m. Manufacturer's written instructions.
    n. Warranty requirements.
    o. Compatibility of materials.
    p. Acceptability of substrates.
    q. Temporary facilities and controls.
    r. Space and access limitations.
    s. Regulations of authorities having jurisdiction.
    t. Testing and inspecting requirements.
    u. Installation procedures.
    v. Coordination with other work.
    w. Required performance results.
    x. Protection of adjacent work.
    y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at monthly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and A/E, each 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 Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of 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 each activity 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.

    1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

    1) Interface requirements.
    2) Sequence of operations.
    3) Status of submittals.
    4) Deliveries.
    5) Off-site fabrication.
    6) Access.
    7) Site use.
    8) Temporary facilities and controls.
    9) Progress cleaning.
    10) Quality and work standards.
    11) Status of correction of deficient items.
    12) Field observations.
    13) Status of RFIs.
    14) Status of Proposal Requests.
    15) Pending changes.
    16) Status of Change Orders.
    17) Pending claims and disputes.
    18) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the 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.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require A/E's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require A/E's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL LIST

A. Submittal List: Submit a listing of all submittals as required by the General Conditions (HECO-7).

1. Submit submittal list as an action submittal.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of A/E.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.

12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by A/E.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by A/E on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

E. Submittals Utilizing A/E’s Web-Based Project Software: Prepare submittals as PDF files unless otherwise indicated.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. A/E’s Web-Based Project Management Software: Prepare submittals in PDF form, and upload to A/E’s web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. A/E reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on A/E's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 7 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. A/E will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 7 days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from A/E's action stamp.

E. 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.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from A/E's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams that show factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on

accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. 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.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

a. Project name and submittal number.
b. Generic description of Sample.
c. Product name and name of manufacturer.
d. Sample source.
e. Number and title of applicable Specification Section.
f. Specification paragraph number and generic name of each item.

3. A/E’s Web-Based Project Management Software: Prepare submittals in PDF form, and upload to A/E’s web-based Project software website. Enter required data in web-based software site to fully identify submittal.
4. Paper Transmittal: Include paper transmittal with Samples, including complete submittal information indicated.
5. 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.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

    a. Number of Samples:

        1) Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line to Owner, unless otherwise indicated. Owner will return submittal with options selected.
        2) Submit duplicate set of Samples to Architect.

7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit three sets of Samples. A/E will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

E. 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 A/Es and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: 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.
3. 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.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. 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 substrate preparation and primers required.
2. 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.
3. 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.
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. 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.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.

b. Date of evaluation.
c. Time period when report is in effect.
d. Product and manufacturers' names.
e. Description of product.
f. Test procedures and results.
g. Limitations of use.

1.7 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 insufficient to perform services or certification required, submit a written request for additional information to A/E.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file 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.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to A/E .

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. A/E will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 A/E'S REVIEW

A. Action Submittals: A/E will review each submittal, indicate corrections or revisions required , and return.

1. PDF Submittals: A/E will indicate, via markup on each submittal, the appropriate action.
2. Submittals by A/E’s Web-Based Project Management Software: A/E will indicate, on Project management software website, the appropriate action.

a. Actions taken by indication on Project management software website have the following meanings:

B. Informational Submittals: A/E will review each submittal and will not return it, or will return it if it does not comply with requirements. A/E will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from A/E.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. A/E will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by A/E without action.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection 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-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

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).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:

a. Verify selections made under Sample submittals.
b. Demonstrate aesthetic effects.

c. Demonstrate the qualities of products and workmanship.
d. Demonstrate successful installation of interfaces between components and systems.
e. Perform preconstruction testing to determine system performance.

2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for 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.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 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.

1.4 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 is 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.

1.5 INFORMATIONAL SUBMITTALS

A. 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.

B. Reports: Prepare and submit certified written reports and documents as specified.

C. 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.

1.6 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address 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. Record of temperature and weather conditions at time of sample-taking and

testing and inspection.

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.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.7 QUALITY ASSURANCE

A. 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. 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.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, 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.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

G. 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.

H. 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.

I. 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 of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect .
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard

for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

1.8 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 inspection 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.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. 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. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.

4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

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 as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspection equipment at Project site.

H. 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 inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.9 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner , as indicated in the Statement of Special Inspections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies

observed in the Work during performance of its services.

3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 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.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

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 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey A/E's action on Contractor's submittals, applications, and requests, "approved" is limited to A/E's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by A/E. Other terms, including "requested," "authorized," "selected," "required," and "permitted," have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms, including "shown," "noted," "scheduled," and "specified," have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

1. For standards referenced by applicable building codes, comply with dates of

standards as listed in building codes.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations, List: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Abbreviations and acronyms not included in this list are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States." The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; (see FGIA).
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; www.concrete.org.
9. ACP - American Clean Power; (Formerly: American Wind Energy Association); www.cleanpower.org.
10. ACPA - American Concrete Pipe Association; www.concretepipe.org.
11. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
12. AF&PA - American Forest & Paper Association; www.afandpa.org.
13. AGA - American Gas Association; www.aga.org.
14. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
16. AI - Asphalt Institute; www.asphaltinstitute.org.
17. AIA - American Institute of Architects (The); www.aia.org.
18. AISC - American Institute of Steel Construction; www.aisc.org.

19. AISI - American Iron and Steel Institute; www.steel.org.
20. AITC - American Institute of Timber Construction; (see PLIB).
21. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
22. AMPP - Association for Materials Protection and Performance; www.ampp.org.
23. ANSI - American National Standards Institute; www.ansi.org.
24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); www.analyzeseeds.com.
25. APA - APA - The Engineered Wood Association; www.apawood.org.
26. APA - Architectural Precast Association; www.archprecast.org.
27. API - American Petroleum Institute; www.api.org.
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASA - Acoustical Society of America; www.acousticalsociety.org.
30. ASCE - American Society of Civil Engineers; www.asce.org.
31. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (see ASCE).
32. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
33. ASME - ASME International; American Society of Mechanical Engineers (The) ; www.asme.org.
34. ASSE - ASSE International; (American Society of Sanitary Engineering); www.asse-plumbing.org.
35. ASSP - American Society of Safety Professionals; www.assp.org.
36. ASTM - ASTM International; www.astm.org.
37. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
38. AVIXA - Audiovisual and Integrated Experience Association; www.avixa.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BSI - British Standards Institution; www.bsigroup.com.
50. BWF - Badminton World Federation; www.bwfbadminton.com.
51. CARB - California Air Resources Board; www.arb.ca.gov.
52. CDA - Copper Development Association Inc.; www.copper.org.
53. CE - Conformite Europeenne (European Commission); www.ec.europa.eu/growth/single-market/ce-marking.
54. CEA - Canadian Electricity Association; www.electricity.ca.
55. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
56. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
57. CGA - Compressed Gas Association; www.cganet.com.

58. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
59. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
60. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
61. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
62. CMHA - Concrete Masonry & Hardscape Association; (Formerly: National Concrete Masonry Association); www.masonryandhardscapes.org.
63. CPA - Composite Panel Association; www.compositepanel.org.
64. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
65. CRRC - Cool Roof Rating Council; www.coolroofs.org.
66. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
67. CSA - CSA Group; www.csagroup.org.
68. CSI - Cast Stone Institute; www.caststone.org.
69. CSI - Construction Specifications Institute (The); www.csiresources.org.
70. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
71. CTA - Consumer Technology Association; www.cta.tech.
72. CTI - Cooling Technology Institute; www.coolingtechnology.org.
73. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
74. DHA - Decorative Hardwoods Association; www.decorativehardwoods.org.
75. DHI - Door and Hardware Institute; www.dhi.org.
76. ECIA - Electronic Components Industry Association; www.ecianow.org.
77. EIMA - EIFS Industry Members Association; www.eima.com.
78. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
79. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; www.esda.org.
80. ESTA - Entertainment Services and Technology Association; www.esta.org.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FGIA - Fenestration and Glazing Industry Alliance; https://fgiaonline.org.
84. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
85. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
86. FM Approvals - FM Approvals LLC; www.fmapprovals.com.
87. FM Global - FM Global; www.fmglobal.com.
88. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.; www.floridaroof.com.
89. FSA - Fluid Sealing Association; www.fluidsealing.com.
90. FSC - Forest Stewardship Council U.S.; www.fscus.org.
91. GA - Gypsum Association; www.gypsum.org.
92. GS - Green Seal; www.greenseal.org.
93. HI - Hydraulic Institute; www.pumps.org.
94. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
95. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
96. IAS - International Accreditation Service; www.iasonline.org.
97. ICC - International Code Council; www.iccsafe.org.
98. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
99. ICPA - International Cast Polymer Association (The); www.theicpa.com.
100. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.

101. IEC - International Electrotechnical Commission; www.iec.ch.
102. IEEE SA - IEEE Standards Association; https://standards.ieee.org.
103. IES - Illuminating Engineering Society; www.ies.org.
104. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
105. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
106. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
107. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
108. Intertek - Intertek Group; www.intertek.com.
109. ISA - International Society of Automation (The); www.isa.org.
110. ISFA - International Surface Fabricators Association; www.isfanow.org.
111. ISO - International Organization for Standardization; www.iso.org.
112. ITU - International Telecommunication Union; www.itu.int.
113. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
114. LPI - Lightning Protection Institute; www.lightning.org.
115. MBMA - Metal Building Manufacturers Association; www.mbma.com.
116. MCA - Metal Construction Association; www.metalconstruction.org.
117. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
118. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
119. MHI - Material Handling Industry; www.mhi.org.
120. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
121. MPI - Master Painters Institute; www.paintinfo.com.
122. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.; www.msshq.org.
123. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
124. NACE - NACE International; (National Association of Corrosion Engineers International); (see AMPP).
125. NADCA - National Air Duct Cleaners Association; www.nadca.com.
126. NAIMA - North American Insulation Manufacturers Association; www.insulationinstitute.org.
127. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
128. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
129. NBI - New Buildings Institute; www.newbuildings.org.
130. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
131. NCMA - National Concrete Masonry Association; (see CMHA).
132. NEBB - National Environmental Balancing Bureau; www.nebb.org.
133. NECA - National Electrical Contractors Association; www.necanet.org.
134. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
135. NEMA - National Electrical Manufacturers Association; www.nema.org.
136. NETA - InterNational Electrical Testing Association; www.netaworld.org.
137. NFHS - National Federation of State High School Associations; www.nfhs.org.
138. NFPA - National Fire Protection Association; www.nfpa.org.
139. NFPA - NFPA International; (see NFPA).
140. NFRC - National Fenestration Rating Council; www.nfrc.org.
141. NGA - National Glass Association; www.glass.org.
142. NHLA - National Hardwood Lumber Association; www.nhla.com.
143. NLGA - National Lumber Grades Authority; www.nlga.org.
144. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).

145. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
146. NRCA - National Roofing Contractors Association; www.nrca.net.
147. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
148. NSF - NSF International; www.nsf.org.
149. NSI - Natural Stone Institute; www.naturalstoneinstitute.org.
150. NSPE - National Society of Professional Engineers; www.nspe.org.
151. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
152. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
153. NWFA - National Wood Flooring Association; www.nwfa.org.
154. NWRA - National Waste & Recycling Association; www.wasterecycling.org.
155. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
156. PDI - Plumbing & Drainage Institute; www.pdionline.org.
157. PLASA - PLASA; www.plasa.org.
158. PLIB - Pacific Lumber Inspection Bureau; www.plib.org.
159. PVCPA - Uni-Bell PVC Pipe Association; www.uni-bell.org.
160. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
161. RFCI - Resilient Floor Covering Institute; www.rfci.com.
162. RIS - Redwood Inspection Service; (see WWPA).
163. SAE - SAE International; www.sae.org.
164. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
165. SDI - Steel Deck Institute; www.sdi.org.
166. SDI - Steel Door Institute; www.steeldoor.org.
167. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
168. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
169. SIA - Security Industry Association; www.securityindustry.org.
170. SJI - Steel Joist Institute; www.steeljoist.org.
171. SMA - Screen Manufacturers Association; www.smainfo.org.
172. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
173. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
174. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
175. SPIB - Southern Pine Inspection Bureau; www.spib.org.
176. SPRI - Single Ply Roofing Industry; www.spri.org.
177. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
178. SSINA - Specialty Steel Industry of North America; www.ssina.com.
179. SSPC - SSPC: The Society for Protective Coatings; (see AMPP).
180. STI/SPFA - Steel Tank Institute/Steel Plate Fabricators Association; www.steeltank.com.
181. SWI - Steel Window Institute; www.steelwindows.com.
182. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
183. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
184. TCNA - Tile Council of North America, Inc.; www.tcnatile.com.
185. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.kbcdco.tema.org.
186. TIA - Telecommunications Industry Association; www.tiaonline.org.
187. TMS - The Masonry Society; www.masonrysociety.org.
188. TPI - Truss Plate Institute; www.tpinst.org.

189. TPI - Turfgrass Producers International; www.turfgrasssod.org.
190. TRI - Tile Roofing Industry Alliance; www.tileroofing.org.
191. ULSE - UL Standards & Engagement Inc.; www.ulse.org.
192. UL - UL Solutions Inc.; www.ul.com.
193. USAV - USA Volleyball; www.usavolleyball.org.
194. USGBC - U.S. Green Building Council; www.usgbc.org.
195. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
196. WA - Wallcoverings Association; www.wallcoverings.org.
197. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
198. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
199. WDMA - Window & Door Manufacturers Association; www.wdma.com.
200. WI - Woodwork Institute; www.woodworkinstitute.com.
201. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
202. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.
2. DOC - U.S. Department of Commerce; www.commerce.gov.
3. DOD - U.S. Department of Defense; www.defense.gov.
4. DOE - U.S. Department of Energy; www.energy.gov.
5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov
6. DOS - U.S. Department of State; www.state.gov.
7. EPA - United States Environmental Protection Agency; www.epa.gov.
8. FAA - Federal Aviation Administration; www.faa.gov.
9. GPO - U.S. Government Publishing Office; www.gpo.gov.
10. GSA - U.S. General Services Administration; www.gsa.gov.
11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
13. NIST - National Institute of Standards and Technology; www.nist.gov.
14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S.

Salinity Laboratory; www.ars.usda.gov.
18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
19. USP - U.S. Pharmacopeial Convention; www.usp.org.
20. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. USAB - United States Access Board; www.access-board.gov.
2. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.2 USE CHARGES

A. Installation, removal, and use charges for temporary facilities to be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Owner will pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Owner will pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Owner will pay electric-power-service use charges for electricity used by all entities for construction operations.

1.3 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established by the Notice to Proceed, submit schedule indicating implementation and termination dates of each temporary utility.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive

materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

3. Indicate methods to be used to avoid trapping water in finished work.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Offices:

1. Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service:

1. Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Electric Power Service:

1. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
2. At each telephone, post a list of important telephone numbers.

a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Contractor's emergency after-hours telephone number.
e. Architect's office.
f. Engineers' offices.
g. Owner's office.
h. Principal subcontractors' field and home offices.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
2. Utilize designated area within existing building for temporary field offices.
3. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.

2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Section 312000 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

F. Storage and Staging: Use designated areas of Project site for storage and staging needs.

G. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of 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.

H. Waste Disposal Facilities:

1. Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."

C. Tree and Plant Protection:

1. Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

D. Pest Control: Engage pest-control service to recommend practices to minimize

attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

E. 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.

F. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -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.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.

2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
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 and require replacing.
    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 and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that

cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of This Section Includes: Administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products unless otherwise indicated.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in "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 product.

B. 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. Evaluating 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.

C. 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 or substitution request, if applicable.

D. 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. Data indicating compliance with the requirements specified in "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 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. 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 inconspicuous.
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.

1.4 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods 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 Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
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 that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections are to 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 standard warranty form furnished by individual manufacturer for a particular product and issued in the name of Owner or endorsed by manufacturer to Owner.

2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of Owner or endorsed by manufacturer to 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 in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, 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 meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in Specifications establish salient characteristics of products.

B. Product Selection Procedures:

1. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.

a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

2. Non-Limited List of Manufacturers: Where Specifications include a list of

available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.

a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

3. 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 may additionally 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 one of the other named manufacturers.

C. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 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 proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for a comparable product. Architect will notify Contractor of approval or rejection of proposed comparable product within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

1. Architect's Approval of Submittal: Marked with approval notation from Architect's action stamp . See Section 013300 "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, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering.
3. Installation.
4. Cutting and patching.
5. Coordination of Owner's portion of the Work.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor .

B. Certified Surveys: Submit two copies signed by land surveyor.

C. Certificates: Submit certificate signed by professional engineer , certifying that location and elevation of improvements comply with requirements.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Professional Engineer Qualifications: See Section 014000 "Quality Requirements."

C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when

encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.
    e. Plumbing piping systems.
    f. Mechanical systems piping and ducts.
    g. Control systems.
    h. Communication systems.
    i. Fire-detection and -alarm systems.
    j. Conveying systems.
    k. Electrical wiring systems.
    l. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

    a. Water, moisture, or vapor barriers.
    b. Membranes and flashings.
    c. Exterior curtain-wall construction.
    d. Sprayed fire-resistive material.
    e. Equipment supports.
    f. Piping, ductwork, vessels, and equipment.
    g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

B. lace Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. 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

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, 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, gas service piping, 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.

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, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
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.

3.2 PREPARATION

A. 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.

B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect . Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb, and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. 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 of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive 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 portions of the 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 with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide

additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. 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 waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.

    a. Use containers intended for holding waste materials of type to be stored.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with 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: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 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.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

B.

1. Substantial Completion procedures.
2. Final Completion procedures.
3. List of incomplete items.
4. Submittal of Project warranties.
5. Final cleaning.

1.2 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner. Label with manufacturer's name and model number.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local

emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect 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. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list will state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect 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. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS

A. Organization 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,listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, 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. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

    a. PDF Electronic File: Architect will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

    1. Submit by uploading to web-based project software site.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

    1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site 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 not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Vacuum and mop concrete.
i. 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.
j. Remove labels that are not permanent.
k. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint droppings, and other foreign substances.
l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
o. Clean luminaires, lamps, globes, and reflectors to function with full

efficiency.

p. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 CORRECTION OF THE WORK

A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

C. Subsystem: A portion of a system with characteristics similar to a system.

1.2 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. A/E will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit by uploading to A/E’s web-based project software site . Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30days before commencing demonstration and training. A/E will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. A/E will return copy with comments.

1. Correct or revise each manual to comply with A/E comments. Submit copies of each corrected manual within 15 days of receipt of A/E's comments and prior to

commencing demonstration and training.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual to contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for A/E.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the A/E that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

D. Manual Contents:. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation in accordance with ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.5 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.6 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data

indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.7 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.
2. Do not use original project record documents as part of maintenance manuals.

1.8 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.

4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Product Data.
3. Miscellaneous record submittals.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:

1) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
2) Submit Record Digital Data Files.
3) A/E will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit three paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned Record Prints and three set(s) of file prints.
3) Print each drawing, whether or not changes and additional information were recorded.

B. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

C. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

1.3 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings

and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints 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 provide information for preparation of corresponding marked-up record prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Field Order.
    k. Changes made following A/E's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Field Order numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.

3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of A/E.
    e. Name of Contractor.

1.4 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.5 MISCELLANEOUS RECORD SUBMITTALS

A. 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.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.6 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart

from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for A/E's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For facilitator.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.3 CLOSEOUT SUBMITTALS

A. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and

maintenance procedures and training.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by A/E.

1.6 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

    a. Startup procedures.
    b. Equipment or system break-in procedures.
    c. Routine and normal operating instructions.
    d. Regulation and control procedures.
    e. Control sequences.
    f. Safety procedures.
    g. Instructions on stopping.
    h. Normal shutdown instructions.
    i. Operating procedures for emergencies.
    j. Operating procedures for system, subsystem, or equipment failure.
    k. Seasonal and weekend operating instructions.
    l. Required sequences for electric or electronic systems.
    m. Special operating instructions and procedures.

5. Adjustments: Include the following:

    a. Alignments.
    b. Checking adjustments.
    c. Noise and vibration adjustments.
    d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

    a. Diagnostic instructions.
    b. Test and inspection procedures.

7. Maintenance: Include the following:

    a. Inspection procedures.
    b. Types of cleaning agents to be used and methods of cleaning.
    c. List of cleaning agents and methods of cleaning detrimental to product.
    d. Procedures for routine cleaning.
    e. Procedures for preventive maintenance.
    f. Procedures for routine maintenance.
    g. Instruction on use of special tools.

8. Repairs: Include the following:

    a. Diagnosis instructions.

b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral performance-based test.

F. Cleanup: Collect used and leftover educational materials and give to Owner . Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 017900

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Form-facing material for cast-in-place concrete.
2. Shoring, bracing, and anchoring.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for formwork related to concrete pavement and walks.

1.2 DEFINITIONS

A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction, movement, contraction, and isolation joints
c. Forms and form-removal limitations.
d. Anchor rod and anchorage device installation tolerances.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Insulating concrete forms.
4. Form ties.
5. Waterstops.

6. Form-release agent.

B. Minutes of preinstallation conference.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:

a. Plywood, metal, or other approved panel materials.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 RELATED MATERIALS

A. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
2. Form release agent for form liners shall be acceptable to form liner manufacturer.

F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

Revise three subparagraphs below to suit Project; delete if not required.

1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301 (ACI 301M).

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M) and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.

C. Limit concrete surface irregularities as follows:

1. Surface Finish-1.0: ACI 117 Class D, 1 inch (25 mm).

D. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips
2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
2. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches (305 mm).

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect prior to forming openings not indicated.

L. Construction and Movement Joints:

1. Construct joints true to line with faces perpendicular to surface plane of concrete.
2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
3. Place joints perpendicular to main reinforcement.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.

    a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

M. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

O. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
5. Clean embedded items immediately prior to concrete placement.

3.3 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

B. Clean and repair surfaces of forms to be reused in the Work.

1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.
2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 031000

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SECTION 032000 - CONCRETE REINFORCING

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. Steel reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:
1. Section 321313 "Concrete Paving" for reinforcing related to concrete pavement and walks.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction contraction and isolation joints.
c. Steel-reinforcement installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Epoxy repair coating.
3. Zinc repair material.
4. Bar supports.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.

2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

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

1. Steel Reinforcement:

B. Minutes of preinstallation conference.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60 , plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch (1.2908 mm) in diameter.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.
2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch (25 mm), not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318 (ACI 318M).

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches (610 mm), whichever is greater.
2. Stagger splices in accordance with ACI 318 (ACI 318M).

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

    a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches (305 mm).

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches (50 mm) for plain wire and 8 inches (200 mm) for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement.
2. Continue reinforcement across construction joints unless otherwise indicated.
3. Do not continue reinforcement through sides of strip placements of floors and slabs.

B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117 (ACI 117M).

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel-reinforcement placement.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, and other pozzolans materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Slag cement.
3. Blended hydraulic cement.
4. Aggregates.
5. 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.

6. Vapor retarders.

7. Curing materials.
8. Joint fillers.

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.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

a. Location of construction joints is subject to approval of the Architect.

D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Vapor retarders.
5. Joint-filler strips.

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

1. Portland cement.

2. Slag cement.
3. Blended hydraulic cement.
4. Aggregates.
5. Admixtures:

C. Research Reports: For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.

D. Minutes of preinstallation conference.

1.6 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. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).

1.8 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 306.1.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M).

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

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

2.2 CONCRETE MATERIALS

A. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type IL.
2. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
3. Blended Hydraulic Cement: ASTM C595/C595M, Type IL, portland-limestone cement.

B. Normal-Weight Aggregates: ASTM C33/C33M, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:

a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. (2.37 kg/cu. m) for moderately reactive aggregate or 3 lb./cu. yd. (1.78 kg/cu. m) for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301 (ACI 301M).

2. Maximum Coarse-Aggregate Size: As indicated.
3. Fine Aggregate: ASTM C33/C33M.

C. Air-Entraining Admixture: ASTM C260/C260M.

D. 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.

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.

E. Water and Water Used to Make Ice: ASTM C94/C94M, complying with ASTM C1602/C1602M.

2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

    a. Ambient Temperature Below 50 deg F (10 deg C): Black.
    b. Ambient Temperature between 50 deg F (10 deg C) and 85 deg F (29 deg C): Any color.
    c. Ambient Temperature Above 85 deg F (29 deg C): White.

C. Curing Paper: Eight-feet- (2438-mm-) wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.

D. Water: Potable or complying with ASTM C1602/C1602M.

E. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

F. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.

G. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.5 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

2.6 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 (ACI 301M).

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
    1. 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.

2.7 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings and grade walls.
    1. Minimum Compressive Strength: As indicated at 28 days.
    2. Maximum w/cm: 0.50.

3. Slump Limit: 8 inches (200 mm), plus or minus 1 inch (25 mm) for concrete with verified slump of 3 inches (75 mm) plus or minus 1 inch (25 mm) before adding high-range water-reducing admixture or plasticizing admixture at Project site

B. Class C: Normal-weight concrete used for interior slabs-on-ground.
1. Minimum Compressive Strength: As indicated at 28 days.
2. Maximum w/cm: 0.40.
3. Air Content:

a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

C. Class J: Normal-weight concrete used for exterior slab on grade, exterior walls and exterior piers exposed to weather.
1. Minimum Compressive Strength: As indicated at 28 days.
2. Maximum w/cm: 0.40.
3. Air Content:
a. 6 percent, plus or minus 1.5 percent at point of delivery.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings, where flashing is shown at other conditions.

3.2 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 walls not less than 6 inches (150 mm), sealing vapor retarder to concrete.
4. Lap joints 6 inches (150 mm) 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 (150 mm) on all sides, and sealing to vapor retarder.

3.3 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.
3. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). 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- (3.2-mm-) 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. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.4 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.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M), but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. 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 (ACI 301M).

    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 (150 mm) 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.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.5 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

    a. Patch voids larger than 1-1/2 inches (38 mm) wide or 1/2 inch (13 mm) deep.
    b. Remove projections larger than 1 inch (25 mm).
    c. Tie holes do not require patching.
    d. Surface Tolerance: ACI 117 (ACI 117M) Class D.
    e. Apply to concrete surfaces [not exposed to public view] <Insert locations>.

2. ACI 301 (ACI 301M)Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

    a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
    b. Remove projections larger than 1/4 inch (6 mm).
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117 (ACI 117M) Class B.
    e. Locations: Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.6 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, 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 (6 mm) in one direction.
3. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

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 restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 (ACI A117M) 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 restraighten until surface is free of trowel marks and uniform in texture and appearance.

3. Grind smooth any surface defects that would telegraph through applied coatings or floor 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 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.

3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches (100 mm) high unless otherwise indicated on Drawings, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings.
3. Minimum Compressive Strength: 4500 psi (31 MPa) at 28 days.
4. For supported equipment, install anchor bolts that extend through concrete base and anchor into structural concrete substrate.
5. Prior to pouring concrete, place and secure anchorage devices.

    a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Cast anchor-bolt insert into bases.
    c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.8 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 (ACI 301M) and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h (1 kg/sq. m x h), calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
b. Continuous Sprinkling: Maintain concrete surface continuously wet.
c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

1) Recoat areas subject to heavy rainfall within three hours after initial application.
2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 (ACI 308.1M) 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 (300-mm).
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

b. Floors to Receive Curing Compound:

1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Maintain continuity of coating, and repair damage during curing period.
4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer[unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project].

c. Floors to Receive Curing and Sealing Compound:

1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.9 TOLERANCES

A. Conform to ACI 117 (ACI 117M).

3.10 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
3. Rinse with water; remove excess material until surface is dry.
4. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.11 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and testing agency to perform field tests and inspections and prepare testing and inspection reports.

1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

    a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

        1) Project name.
        2) Name of testing agency.
        3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
        4) Name of concrete manufacturer.
        5) Date and time of inspection, sampling, and field testing.
        6) Date and time of concrete placement.
        7) Location in Work of concrete represented by samples.
        8) Date and time sample was obtained.
        9) Truck and batch ticket numbers.
        10) Design compressive strength at 28 days.
        11) Concrete mixture designation, proportions, and materials.
        12) Field test results.
        13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.

14) Type of fracture and compressive break strengths at seven days and 28 days.

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.

C. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall 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. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

   a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM 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. Slump Flow: ASTM C1611/C1611M:

   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.

4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; [ASTM C173/C173M volumetric method, for structural lightweight concrete].

   a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: ASTM C1064/C1064M:

   a. One test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.

6. Compression Test Specimens: ASTM C31/C31M:

    a. Cast and laboratory cure two sets of three 6-inch (150 mm) by 12-inch (300 mm) or 4-inch (100 mm) by 8-inch (200 mm) cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C39/C39M.

    a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days. Retain one cylinder from each set for additional testing.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. 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 (3.4 MPa) if specified compressive strength is 5000 psi (34.5 MPa), or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi (34.5 MPa).
9. 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.
10. Additional Tests:

    a. 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.
    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 shall be in accordance with ACI 301 (ACI 301M), section 1.6.6.3.

11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness in accordance with ASTM E1155 (ASTM E1155M) within 24 hours of completion of floor finishing and promptly report test results to Architect.

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 concrete surfaces scheduled to receive surface hardener Floor Slab Protective Covering.

END OF SECTION 033000

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal bollards.

1.2 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details. Include sections and details of metal fabrications and their connections. Show anchorage and accessory items.

1.3 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

2.2 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099114 "Exterior Painting (MPI Standards)."and Section 099124 "Interior Painting (MPI Standards)."

B. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete".

2.3 FABRICATION OF METAL, GENERAL

A. Cut 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.

2.4 METAL BOLLARDS

A. Metal Bollards: Fabricate metal bollards from Schedule 40 steel pipe.

B. Prime steel bollards with shop primer.

2.5 STEEL AND IRON FINISHES

A. Shop prime iron and steel items unless otherwise indicated.

1. Shop prime with primers specified in Section 099114 "Exterior Painting (MPI Standards and Section 099124 "Interior Painting (MPI Standards)".

B. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION OF METAL FABRICATIONS, GENERAL

A. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, and true, and measured from established lines and levels.

B. Provide temporary bracing or anchors for items that are to be built into concrete.

3.2 INSTALLATION OF METAL BOLLARDS

A. Anchor bollards in place in concrete. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

3.3 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION 055000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Fire-retardant-treated lumber.
3. Plywood backing panels.

1.2 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product. Indicate component materials and dimensions and include construction and application details.

1. 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.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 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

2.1 WOOD LUMBER, GENERAL

A. Lumber: Comply with DOC PS 20 and with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: 19 percent.
2. Dimension Lumber: 19 percent.

2.2 FIRE-RETARDANT-TREATED LUMBER

A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 ft. beyond the centerline of the burners at any time during the test.

1. Treatment is not to promote corrosion of metal fasteners.
2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Exterior type may be used for interior locations in lieu of interior type.
3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use for interior applications.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.

E. Application: Treat items indicated on Drawings, and the following:

1. Concealed blocking.
2. Plywood backing panels.

2.3 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.

B. Dimension Lumber Items:

1. Grade: Construction or No. 2, Standard, Stud, or No. 3.
2. Species: Any species.

C. Concealed Boards:

1. Lumber Moisture Content: 19 percent maximum.
2. Species and Grade: Any species.

D. Exposed Boards: Hand-select material for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, shake, splits, torn grain, and wane.

1. Species and Grade: Softwood boards, any species, No. 2 grade or better.

2.4 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1.

1. Grade: Exterior, A-C, fire-retardant treated.
2. Thickness: As indicated on the drawings or, if not indicated, not less than3/4-inch nominal thickness.

2.5 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. Provide fasteners of types required to securely fasten wood products to adjacent substrates and to support attached loads.

B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

1. Fasteners for Exposed Boards and Plywood attached to Metal Studs, Cold-Formed Metal Framing, or Pre-Engineered Metal Building Liner Panels: Self-drilling metal screws having countersunk heads.

C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01ICC-ES AC58ICC-ES AC193orICC-ES AC308 as appropriate for the substrate.

PART 3 - EXECUTION

3.1 INSTALLATION OF ROUGH CARPENTRY, GENERAL

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate blocking and similar

supports to comply with requirements for attaching other construction.

B. Plywood Backing Panels: Install backing panels by fastening to studs and pre-engineered metal building liner panels; coordinate locations with utilities requiring backing panels.

C. Exposed Boards: Fit boards accurately to other construction, with faces and edges in alignment. Fasten to substrates with indicated screws. Align screws vertically and horizontally and space equally.

D. Provide blocking as indicated and as required to support facing materials, fixtures, specialty items, and trim.

3.2 INSTALLATION OF WOOD BLOCKING

A. Install wood blocking where indicated on Drawings 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.

END OF SECTION 061000

SECTION 064100 - ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad casework.
2. Wood materials.
3. Casework hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include panel material description and finish.
2. Include hardware.

B. Shop Drawings:

1. Plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: For each exposed product and for each color and finish specified, in manufacturer's standard size.

D. Samples for Verification: Not required.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of products.

1.4 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical architectural cabinets as indicated on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Unless otherwise indicated, comply with ANSI/AWI 0641 for duty level and grade of architectural cabinets indicated for construction, finishes, installation, and other requirements.

2.2 PLASTIC-LAMINATE-CLAD CASEWORK

A. Architectural Woodwork Institute (AWI) Standard:

1. Structural Performance Duty Level: 3.
2. Aesthetic Performance Grade: Custom.

B. Casework Construction Type: Frameless.

C. Door and Drawer-Front:

1. Design: Flush panel.
2. Style: Reveal overlay.

a. Reveal Dimension: 1/2 inch.

D. High-Pressure Decorative Laminate (HPDL): ISO 4586-3, grades as indicated or, if not indicated, as required by quality standard.

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. ABET Inc.
b. Formica Corporation
c. Laminart LLC
d. Nevamar Company, LLC

e. Wilsonart LLC

E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.

F. Exposed Exterior Surfaces:

1. Plastic-Laminate Grade: HGS for horizontal surfaces and VGS for vertical surfaces.
2. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
3. Edgebanding: High-pressure decorative laminate (HPDL).

G. Exposed Interior Surfaces: Thermally fused laminate (TFL).

1. Edgebanding: High-pressure decorative laminate (HPDL).

H. Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermally fused laminate (TFL) panels.
2. Drawer Sides and Backs: Thermally fused laminate (TFL) panels with PVC or polyester edgebanding.
3. Semiexposed and Concealed Surfaces of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate (HPDL), ISO 4583-3, grade to match exposed surface.
4. Drawer Bottoms: Thermally fused laminate (TFL) panels.
5. Shelves: Adjustable.

a. Loading Capacity: 40 lb/sq. ft.

6. Edgebanding: PVC or ABS, 0.018-inch minimum thickness.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content:

a. Climate-Controlled Environments: 6 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Composite Wood Products: Verify formaldehyde emission rates are not greater than the following when tested in accordance with ASTM D6007 or ASTM E1333:

a. Particleboard: 0.09 ppm.
b. MDF More Than 5/16 Inch (8 mm) Thick: 0.11 ppm.

2. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
3. Particleboard (Medium Density): ANSI A208.1, Grade M-2.
4. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper.

2.4 CASEWORK HARDWARE

A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Hinges:

1. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 115-140 degrees of opening.

C. Pulls and Knobs:

1. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

D. Shelf Rests and Standards:

1. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.

E. Drawer Slides: ANSI/BHMA A156.9.

1. Heavy-Duty (Grade 1HD and Grade 1HD-200): Side mount.

a. Type: Full extension.
b. Material: Galvanized-steel ball-bearing slides.

2. Drawer Types:

a. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 75 lb load capacity.

F. Door Bumpers: Manufacturer's standard self-adhering clear silicone pads.

G. Hardware Finish:

1. Exposed Hardware: Provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.

a. Satin Stainless Steel: ANSI/BHMA 630.

2. Concealed Hardware: Manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

A. Adhesives: Do not use adhesives that contain urea formaldehyde.

B. Adhesive for Bonding Plastic Laminate: Type I, waterproof type as selected by fabricator to comply with requirements.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.6 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.
2. Verify size and locations of cutouts for appliances, special equipment, sinks, plumbing, and other items to be mounted in or adjacent to casework.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.3 INSTALLATION OF CASEWORK

A. Install casework to comply with requirements of the structural and aesthetic performance specified.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

D. Anchor cabinets in accordance with AWI requirements or tested method to anchors or blocking built in or directly attached to framing or substrates.

E. Shop Finishes: Touch up finishing after installation of architectural cabinets. Fill nail holes with matching filler.

3.4 ADJUSTING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where impossible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

3.5 CLEANING

A. Clean, lubricate, and adjust hardware and other moving parts to function smoothly.

B. Clean cabinets on exposed and semiexposed surfaces. Touch up finishes to restore damaged or soiled areas.

END OF SECTION 064100

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation (XPS).
2. Glass-fiber blanket insulation.
3. Insulation for miscellaneous voids.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than Class A, 25 and 450 when tested in accordance with ASTM E84.

B. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

C. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

D. Thickness: As indicated on Drawings.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION (XPS)

A. Extruded Polystyrene Board Insulation, Type IV: ASTM C578, Type IV, 25 psi minimum compressive strength; unfaced.

2.3 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.

B. Glass-Fiber Blanket Insulation, Foil Faced: ASTM C665, Type III, Class B; Category 1.

1. Facing: Foil-scrim kraft.

2.4 INSULATION FOR MISCELLANEOUS VOIDS

A. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, in accordance with ASTM E84.

B. Spray-Applied Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ASTM E84.

2.5 ACCESSORIES

A. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or those that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products, applications and applicable codes.

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. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. 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.

3.3 INSTALLATION OF PERIMETER INSULATION

A. Butt panels together for tight fit.

B. Adhesive Installation: Install with adhesive in accordance with manufacturer's written instructions.

C. Miscellaneous Voids: Fill with spray-applied foam insulation.

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members in accordance with the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. For metal-framed wall cavities where cavity heights exceed 96 inches, support faced blankets by taping flanges of insulation to flanges of metal studs.
4. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

    a. Exterior Walls: Set units with facing placed toward as indicated on Drawings.
    b. Interior Walls: Set units with facing placed as indicated on Drawings.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..

3.5 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 077253 - SNOW GUARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pad-type, seam-mounted cast-metal snow guards.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1. Pad-type, seam-mounted cast-metal snow guards.

B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.

C. Samples:

1. Pad-Type Snow Guards: Full-size unit with installation hardware.

D. Delegated Design Submittals: For snow guards, include analysis reports signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include calculation of number and location of snow guards.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that the engineer is licensed in the state in which the Project is located.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design snow guards, including attachment to roofing material and roof deck, as applicable for attachment method, based on the following:

1. Roof snow load.

2. Snow drifting
3. Roof slope.
4. Roof type.
5. Roof dimensions.
6. Roofing substrate type and thickness.
7. Snow guard type.
8. Snow guard fastening method and strength.
9. Snow guard spacing.
10. Coefficient of Friction Between Snow and Roof Surface: 0.
11. Factor of Safety: Minimum of 2.

B. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

C. Structural Performance: Snow guards to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Snow Loads: As indicated on Drawings.

2.2 PAD-TYPE SNOW GUARDS

A. Pad-Type, Seam-Mounted Cast-Metal Snow Guards:

1. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Alpine SnowGuards “ASG33G Pad-Style Snow Guard, U-Clamp Configuration.”
b. Berger; division of OmniMax International, Inc., “APA400M Snow Guard.”
c. Jalco Manufacturing “TAF Standing Seam Snow Guard.”

2. Material:

a. Cast Aluminum: ASTM B26/B26M; mill finish.

3. Attachment: Manufacturer's tested system, capable of resisting design loads.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install snow guards according to manufacturer's written instructions.

1. Space rows as indicated on Shop Drawings.

B. Attachment for Standing-Seam Metal Roofing:

1. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.
2. Pad-Type, Seam-Mounted Snow Guards:

a. Install snow guards in straight rows.
b. Secure in place using stainless steel set screws, incorporating round nonpenetrating point.
c. Torque set screw in accordance with manufacturer's written instructions.

END OF SECTION 077253

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SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Mildew-resistant joint sealants.
4. Butyl joint sealants.
5. Joint sealant backings.

B. Related Requirements:

1. Section 133419 “Metal Building Systems” for sealants furnished and installed as part of the pre-engineered metal building system.
2. Sealants for exterior horizontal joints in traffic surfaces: Refer to civil drawings and specifications.
3. Semi-rigid joint filler for joints in concrete floor slabs: Refer to civil drawings and specifications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include preparation requirements and installation instructions.
2. Indicate VOC content.

B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint Sealant Schedule: Include the following information:

1. Joint sealant application, joint location, and designation.
2. Joint sealant manufacturer and product name.
3. Joint sealant formulation.
4. Joint sealant color.
5. Joint sealant backing or joint filler.
6. Joint size (width and depth).
7. Tooled joint profile.

E. Qualification Statements: For Installer.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

1.4 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

A. Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application indicated, and as indicated within approved joint sealant schedule submittal based on joint sealant manufacturer's testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 MILDEW-RESISTANT JOINT SEALANTS

A. General: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

2.4 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealant: ASTM C1311, non-hardening butyl mastic.

2.5 JOINT SEALANT ACCESSORIES

A. Joint Sealant Backings: Provide joint sealant backings that are nonstaining, compatible with joint substrates, sealants, primers, and other joint fillers under conditions of service and application indicated, and as indicated within approved joint sealant schedule submittal based on joint sealant manufacturer's testing and field experience.

1. Cylindrical Sealant Backings: ASTM C1330, of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

    a. Classification: Type C.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended in writing by joint sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials, or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended in writing by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Porous Joint Substrate Surfaces: Clean by brushing, grinding, mechanical

abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

a. Concrete.

3. Concrete Substrate Surfaces: Remove laitance and form-release agents from concrete.
4. Nonporous Joint Substrate Surfaces: Clean with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

a. Metal.
b. Glass.

B. Joint Priming: Prime joint substrates where recommended by joint sealant manufacturer or as indicated by preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant and backing manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Joint Sealant Backings: Install backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Bond-Breaker Tape: Install tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Joint Sealants: Install using proven techniques that comply with the following and at the

same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT SEALANT SCHEDULE

A. Exterior Joints in Vertical Surfaces and Horizontal Nontraffic Surfaces:

1. Joint Locations:

    a. Perimeter joints between surrounding materials and frames of doors, windows, and louvers.

2. Joint Sealant: Silicone, neutral-curing sealant, Type S, Grade NS, Class 50, Use NT.

B. Interior Joints in Vertical Surfaces and Horizontal Nontraffic Surfaces:

1. Joint Locations:

a. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
b. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane sealant, Type S, Grade NS, Class 50, Use NT.

C. Mildew-Resistant Interior Joints in Vertical Surfaces and Horizontal Nontraffic Surfaces:

1. Joint Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew-resistant, acid-curing sealant, Type S, Grade NS, Class 25, Use NT.

D. Concealed Mastics:

1. Joint Locations:

a. Aluminum thresholds.
b. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl rubber-based joint sealant.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard exterior hollow metal doors and frames.
2. Standard interior hollow metal doors and frames.

1.2 COORDINATION

A. Coordinate requirements for installing door hardware, including electrified door hardware.

1.3 DEFINITIONS

A. Minimum Steel Sheet Thickness: Minimum thickness of base metal without coatings in accordance with ANSI/SDI A250.8.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include construction details, material descriptions, core descriptions, and finishes.
2. Include information indicating compliance with performance requirements indicated.

B. Shop Drawings:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and base-metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and base-metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware,.
7. Details of frame anchors,.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

C. Product Schedule: For hollow metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings used on the Drawings and in schedules. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For tests performed by a qualified testing agency for the following:

1. Thermally rated door assemblies.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic, canvas, or other material that can entrap moisture.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

D. Immediately remove and replace damaged or wet packaging or protective material.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain hollow metal doors and frames from single manufacturer.

B. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.50 deg Btu/F x h x sq. ft when tested in accordance with ASTM C1363 or ASTM E1423.

2.2 STANDARD EXTERIOR HOLLOW METAL DOORS AND FRAMES

A. Exterior Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.

1. Steel Sheet: Minimum A60 metallic coating.
2. Doors: 1-3/4 inches thick.

a. Faces: Steel sheet; minimum 0.053-inch base-metal thickness.
b. Edge Construction: Model 2, Seamless.
c. Edge Bevel: Provide manufacturer's standard beveled or square edges .
d. End Closures: Steel sheet; minimum 0.042-inch base-metal thickness. Flush top channel sealed against water penetration and flush bottom channel with weep-hole openings to permit moisture to escape.
e. Cores: Polyurethane.

3. Frames: Steel sheet; minimum 0.053-inch base-metal thickness.

    a. Construction: Full-profile welded.
4. Exposed Finish: Prime painted.

2.3 STANDARD INTERIOR HOLLOW METAL DOORS AND FRAMES

A. Interior Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.

1. Steel Sheet: Metallic coated.
2. Doors: 1-3/4 inches thick.

    a. Faces: Steel sheet; minimum 0.042-inch base-metal thickness.
    b. Edge Construction: Model 1, Full Flush .
    c. Edge Bevel: Provide manufacturer's standard beveled or square edges.
    d. Cores: Manufacturer's standard.

3. Frames: Steel sheet; minimum 0.053-inch base-metal thickness.

    a. Construction: Face welded or full-profile welded.

4. Exposed Finish: Prime painted.

2.4 ACCESSORIES

A. Door Vision Lite Frames: Steel sheet matching door face material; minimum 0.032-inch base-metal thickness.

1. Profile: Flush type, with square or beveled stops.
2. Corner Construction: or mitered and welded.
3. Fasteners: Countersunk.

B. Frame Anchors: ANSI/SDI 250.4; steel sheet; minimum base-metal thickness required by door and frame standard indicated.

1. Interior Locations: ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.
2. Exterior-Wall Anchors: ASTM A653/653M, A60 metallic coating.
3. Jamb Anchors: Of minimum size and type required by door and frame standard indicated, and suitable for performance level indicated.

    a. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 ft..

4. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

2.5 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.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

E. 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.

F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.6 FABRICATION

A. Hollow Metal Frames:

1. Welded 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 from metal of same or greater thickness as frames.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers. 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 in accordance with ANSI/SDI A250.6, the door hardware required, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with ANSI/SDI A250.14 for preparing hollow metal doors and frames for hardware.

C. Door Vision Lite Frames:

1. Rabbets: Coordinate width between fixed and removable stops with glazing and installation types indicated.
2. Fastener Spacing: Not more than 9 inches o.c. and not more than 2 inches from each corner.

2.7 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION OF STANDARD EXTERIOR HOLLOW METAL DOORS AND FRAMES

A. Install in accordance with ANSI/SDI A250.8 and ANSI/SDI A250.11.

B. Install hollow metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

C. Mineral-Fiber Insulation: Solidly pack mineral-fiber insulation inside frames.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow metal door and frame manufacturer's written instructions.

3.4 INSTALLATION OF STANDARD INTERIOR HOLLOW METAL DOORS AND FRAMES

A. Install in accordance with ANSI/SDI A250.8 and ANSI/SDI A250.11.

B. Install hollow metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

C. Mineral-Fiber Insulation: Solidly pack mineral-fiber insulation inside frames.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow metal door and frame manufacturer's written instructions.

3.5 ADJUSTING

A. Remove and replace defective work, including frames that are warped, bowed, or otherwise defective.

B. 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.

C. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.

END OF SECTION 081113

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flush access doors with exposed flanges.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For access doors and frames.

1. Indicate access door, locations, sizes, and other data pertinent to installation.

1.3 COORDINATION

A. Determine specific locations and sizes for access doors needed for access to concealed plumbing, HVAC, electrical, and other work, and indicate in schedule specified in “Submittals” Article.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:

1. Description: Face of door flush with frame, with exposed flange and concealed hinge.
2. Locations: Wall.
3. Door Size: Provide access doors having opening dimensions necessary to provide full access to concealed equipment for adjustment, maintenance, and replacement, but not less than 8 inches by 8 inches square.
4. Stainless Steel Sheet for Door: Nominal 0.062 inch, 16 gage, ASTM A480/A480M No. 4 finish.
5. Frame Material: Same material, thickness, and finish as door.
6. Latch and Lock: Cam latch, screwdriver operated.

2.2 MATERIALS

A. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

B. Stainless Steel Flat Bars: ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices, and fasteners of type required to secure access doors to types of supports indicated.

D. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.

2.4 FINISHES

A. Comply with NAAMM/NOMMA AMP 500 for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are 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.

D. Stainless Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finish: ASTM A480/A480M No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.

    a. Run grain of directional finishes with long dimension of each piece.
    b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates 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 INSTALLATION OF ACCESS DOORS AND FRAMES

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

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SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel sectional doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

D. Samples for Initial Selection: For units with factory-applied finishes.

1. Include Samples of accessories involving color selection.

E. Samples for Verification: For each type of exposed finish and for each color and texture required on the following components, in manufacturer's standard sizes:

1. Glazing.
2. Metal for door sections.
3. Hardware.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranties: For manufacturer's warranty and finish warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sectional doors to include in maintenance manuals.

B. Manufacturer's warranty.

C. Finish warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Failure of components or operators before reaching required number of operation cycles.
c. Faulty operation of hardware.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
e. Delamination of exterior or interior facing materials.

2. Warranty Period: Two years from date of Substantial Completion.

B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

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

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations: Obtain sectional doors from single source from single manufacturer.

1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: As indicated on Drawings.
2. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.

a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of door width.
b. Deflection of horizontal track assembly shall not exceed 1/240 of door height.

C. Operation Cycles: Door components and operators capable of operating for not less than 25,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.

D. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. when tested in accordance with ASTM E283 or DASMA 105.

E. U-Value: Not more than 0.135 Btu/sq. ft. x h x deg F.

2.3 SECTIONAL DOORS

A. Steel Sectional Doors: Provide sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; is free of warp, twist, and deformation; and complies with requirements in DASMA 102.

1. Door-Section Thickness: 1-1/2 inches minimum.

a. Section Faces:

1) Thermal-Break Construction: Provide sections with continuous thermal-break construction separating the exterior and interior faces of door.
2) Exterior Face: Fabricated from single sheets, not more than 24 inches high; with horizontal meeting edges rolled to continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove, weather- and pinch-resistant seals and reinforcing flange return.
3) Steel Sheet Thickness: 0.022-inch minimum nominal coated thickness.
4) Surface: Manufacturer's standard, flat or grooved.

b. Interior Face: Enclose insulation completely within steel exterior facing and interior facing material, with no exposed insulation. Provide the following

interior-facing material:

1) Zinc-Coated (Galvanized) Steel Sheet: With minimum nominal coated thickness of 0.019 inch and as recommended in writing by manufacturer to comply with performance requirements.

2. End Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.040-inch nominal coated thickness and welded to door section.
3. Section Reinforcing: Horizontal and diagonal reinforcement as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.

   a. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile and allowing installation of weatherseal.
   b. Hardware Locations: Provide reinforcement for hardware attachment.

4. Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free insulation of type indicated below:

   a. Foamed-in-Place Insulation: Polyurethane, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load.
   b. Fire-Resistance Characteristics: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ASTM E84.

B. Track: Manufacturer's standard, galvanized-steel,high-lift track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.

1. Material: Galvanized steel, ASTM A653/A653M, minimum G60 zinc coating.
2. Size: As recommended in writing by manufacturer for door size, weight, track configuration and door clearances indicated on Drawings .
3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.

   a. Vertical Track: Incline vertical track to ensure weathertight closure at jambs. Provide intermittent jamb brackets attached to track and wall.
   b. Horizontal Track: Provide continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.

C. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom topandjambs of door. Provide combination bottom weatherseal and sensor edge for bottom seal.

D. Windows: Manufacturer's standard window units of shape and size and in locations indicated on Drawings. Set glazing in vinyl, rubber, or neoprene glazing channel. Provide removable stops of same material as door-section frames. Provide the following glazing:

1. Insulating Glass Units: Manufacturer's standard .

E. Counterbalance Mechanism:

1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.
    a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.
    b. Provide one additional midpoint bracket for shafts up to 16 ft. long and two additional brackets at one-third points to support shafts more than 16 ft. long unless closer spacing is recommended in writing by door manufacturer.
3. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 5 to 1.
4. Cable Safety Device: Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if lifting cable breaks.
5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
6. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

F. Electric Door Operator: Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA IA 10030; with NFPA 70, Class 2 control circuit, maximum 24 V ac or dc.
3. Safety: Listed in accordance with UL 325 by a qualified testing agency for commercial or industrial use ; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower .
4. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
5. Operator Type: Manufacturer's standard for door requirements .
6. Motor: Reversible-type with controller (disconnect switch) for interior, clean, and dry motor exposure. Use adjustable motor-mounting bases for belt-driven operators.

a. Motor Size: As required to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor1/3 hp but not less than 1/2 hp.
b. Electrical Characteristics:

1) Phase: Single phase.
2) Volts: 120 V.

7. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
8. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

a. Monitored Entrapment Protection: Electric sensor edge on bottom section designed to interface with door-operator control circuit to detect damage to or disconnection of sensor and complying with requirements in UL 325.

9. Control Station: Surface mounted, three-position (open, close, and stop) control.

a. Operation: Push button .
b. Interior-Mounted Unit: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA IA 10030, Type 1 enclosure.

10. Emergency Manual Operation: Chain type designed so required force for door operation does not exceed 25 lbf.
11. Emergency Operation Disconnect Device: Hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
12. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

G. Metal Finish: Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

1. High-Performance (Two-Coat Fluoropolymer): Organic Coating; manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Color and Gloss: As selected by Architect from manufacturer's full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SECTIONAL DOORS

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.

B. Tracks:

1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than 24 inches apart.
2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operated Doors: Install automatic garage doors openers in accordance with UL 325.

3.3 SYSTEM STARTUP

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed entrance and storefront systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each specified system and assembly, including components and accessories.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include operating characteristics and furnished accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, full-size details, and attachments to other work.
2. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

D. Samples for Verification: Actual sample of finished products for each type of exposed finish.

E. Delegated Design Submittals: For aluminum-framed entrance and storefront systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: For aluminum-framed entrance and storefront systems, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront system.

B. Product Test Reports: For aluminum-framed entrance and storefront systems, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For aluminum-framed entrance and storefront systems.

B. Warranty Documentation: For specified special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: One of the following:

1. Fabricator of products.
2. Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrance and storefront systems that fail in materials or workmanship within specified warranty period.

1. Deterioration of metals , metal finishes, and other materials beyond normal weathering.
2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrance and storefront systems.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrance and storefront systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrance and storefront systems to withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.

D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of length of span of the framing member for lengths of up to 13 ft. 6 inches and to 1/240 of length of span of the framing member plus 1/4 inch for lengths greater than 13 ft. 6 inches.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

E. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

G. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

H. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
2. Maximum Water Leakage: In accordance with AAMA 501.1No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation . Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

I. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.34 Btu/sq. ft. x h x deg F as determined in accordance with ANSI/NFRC 100.
b. Entrance Doors: U-factor of not more than 0.60 Btu/sq. ft. x h x deg F as determined in accordance with ANSI/NFRC 100.

2. Solar Heat-Gain Coefficient (SHGC):

a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.30 as determined in accordance with ANSI/NFRC 200.
b. Entrance Doors: SHGC of not more than 0.35 as determined in accordance with ANSI/NFRC 200.

3. Air Leakage:

a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft at a static-air-pressure differential of 6.24 lbf/sq. ft when tested in accordance with ASTM E283/E283M.
b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. when tested in accordance with ASTM E283/E283M.

4. Condensation Resistance Factor (CRF):

a. Fixed Glazing and Framing Areas: CRF for the system of not less than 65 as determined in accordance with AAMA 1503.
b. Entrance Doors: CRF of not less than 65 as determined in accordance with AAMA 1503.

2.3 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

A. Aluminum-Framed Entrance and Storefront System:

1. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

    a. Exterior Framing Construction: Thermally broken.

        1) Where necessary to meet performance requirements, provide framing fabricated with double thermal breaks.

    b. Glazing System: Retained mechanically with gaskets on four sides.
    c. Glazing Plane: Front-set.
    d. Finish: High-performance organic finish.
    e. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    f. Steel Reinforcement: As required by manufacturer.

2. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
3. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
4. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or power operation.

    a. Door Construction 2- to 2-5/8-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

        1) Thermal Construction: Thermally broken.

            a) Where necessary to meet performance requirements, provide doors fabricated with double thermal breaks.

    b. Door Design: Wide stile; 5-inch nominal width.
    c. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

        1) Provide nonremovable glazing stops on outside of door.

    d. Finish: Match adjacent storefront framing finish.

5. Entrance Door Hardware:

a. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087111 "Door Hardware (Descriptive Specification)."
b. General: Provide entrance door hardware and for each entrance door, to comply with requirements in this Section.

    1) Entrance Door Hardware : Provide quantity, item, size, finish or color indicated, and products complying with ANSI/BHMA standard referenced .
    2) Opening-Force Requirements:

        a) Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.

c. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are identified by using entrance door hardware designations as follows:

    1) References to ANSI/BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

d. Continuous-Gear Hinges: ANSI/BHMA A156.26.
e. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
f. Weather Stripping: Manufacturer's standard replaceable components.

    1) Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
    2) Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

g. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
h. Thresholds: ANSI/BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

6. Glazing: Comply with Section 088000 "Glazing."
7. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
8. Glazing Sealants: As recommended in writing by manufacturer.

    a. Verify architectural sealant has a VOC content of 250 g/L or less.

9. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-

glazed storefront manufacturers for this use.

a. Color: Match structural sealant.
b. Verify architectural sealant has a VOC content of 250 g/L or less.

2.4 ACCESSORIES

A. Power Door Operators: Section 087113 "Power Door Operators."

B. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads , finished to match framing system, fabricated from 300 series stainless steel .

C. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

D. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

E. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

F. Joint Sealants and Backings: Provide joint sealants, backings, and other related materials in accordance with Section 079200 "Joint Sealants."

2.5 MATERIALS

A. Sheet and Plate: ASTM B209/B209M.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with

applicable SSPC standard.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from interior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.7 ALUMINUM FINISHES

A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with

coating and resin manufacturers' written instructions.
2. Color and Gloss: As selected by Architect from manufacturer's full range. Insert color and gloss.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

A. General: Install aluminum-framed entrance and storefront systems in accordance with manufacturer's written instructions.

1. Do not install damaged components.
2. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal perimeter and other joints watertight unless otherwise indicated.
3. Install components plumb and true in alignment with established lines and grades.

B. Anchorage:

1. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

C. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

D. Joint Sealants and Backings: Install in accordance with Section 079200 "Joint Sealants."

1. Set continuous sill members and flashing in full sealant bed.
2. Seal perimeter of framing members with sealant.

E. Entrance Doors: Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather

stripping.

2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

F. Glazing: Install glazing as specified in Section 088000 "Glazing."

3.3 ERECTION TOLERANCES

A. Install aluminum-framed entrance and storefront systems to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 ft.; 1/4 inch in 40 ft..
2. Level: 1/8 inch in 20 ft.; 1/4 inch in 40 ft..
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 ft.; 1/2 inch over total length.

3.4 ADJUSTING

A. Adjust hardware and operable components to function smoothly, and lubricate as recommended in writing by manufacturer.

END OF SECTION 084113

SECTION 087111 - DOOR HARDWARE (DESCRIPTIVE SPECIFICATION)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hardware for swinging doors.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory 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. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include details of interface of electrified door hardware and building safety and security systems.

C. Door Hardware Schedule: Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
2. Content: Include the following information:

a. Identification number, location, hand, size, and material of each door and frame.
b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.

e. Fastenings and other installation information.
f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
g. Mounting locations for door hardware.
h. List of related door devices specified in other Sections for each door and frame.

D. Keying Schedule: Detailing Owner's final keying instructions for locks.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lockup for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.5 WARRANTY

A. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

1. Exit Devices: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of door hardware from single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

A. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified

testing agency, and marked for intended location and application.

B. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

C. Accessibility Requirements: Comply with the USDOJ's "2010 ADA Standards for Accessible Design.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Comply with the following maximum opening-force requirements:

a. Interior, Hinged Doors: 5 lbf applied perpendicular to door.
b. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
c. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.

2.3 HINGES

A. Hinges: ANSI/BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

B. Antifriction-Bearing Hinges:

1. Mounting: Full mortise.
2. Bearing Material: Ball bearing.
3. Grade 1 (heavy weight).
4. Base and Pin Metal:

a. Exterior Hinges: Stainless steel with stainless steel pin.
b. Interior Hinges: Stainless steel with stainless steel pin.

5. Pins: Nonrising loose unless otherwise indicated.

a. Outswinging Exterior Doors: Nonremovable.

6. Tips: Flat button.

2.4 CONTINUOUS HINGES

A. Continuous, Gear-Type Hinges: ANSI BHMA A156.26; minimum 0.120-inch-thick, extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings. Minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

1. Basis-of-Design Product: Subject to compliance with requirements, provide hinges manufactured by Select Products Limited, or comparable product by one of the following:

a. Allegion plc
b. Hager Companies
c. McKinney Products Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY
d. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY
e. STANLEY; dormakaba USA, Inc.
f. Zero International; Allegion plc

2. Grade 1-300.

2.5 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch latchbolt throw.
2. Deadbolts: Minimum 1-inch bolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim: Best “X15D” lever trim.
1. Levers: Wrought, forged, or cast.
2. Escutcheons (Roses): Wrought, forged, or cast.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

F. Bored Locks: ANSI/BHMA A156.2, Grade 1, Series 4000.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Best “9K3 Series” or comparable product by one of the following:

a. Allegion plc
b. Corbin Russwin, Inc.; an ASSA ABLOY Group company
c. Hager Companies
d. SARGENT Manufacturing Company; ASSA ABLOY
e. STANLEY; dormakaba USA, Inc.
f. Yale Security Inc; ASSA ABLOY

2. Deadbolts for Toilet Doors: ANSI A156.12, Grade 1. Provide deadbolts having ADA lever on toilet side and occupancy indicator with emergency key override on exterior side.

2.6 ELECTRIC STRIKES

A. Electric Strikes: ANSI/BHMA A156.31, Grade 1; with faceplate to suit lock and frame.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Von Duprin “6000 Series” or comparable product by one of the following:

    a. ASSA ABLOY Electronic Security Hardware; ASSA ABLOY
    b. STANLEY; dormakaba USA, Inc.

2. Material: Stainless steel.
3. Mounting: Mortised.

2.7 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: ANSI/BHMA A156.3.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Von Duprin “33A/99 Series” or comparable product by one of the following:

    a. Allegion plc
    b. Corbin Russwin, Inc.; an ASSA ABLOY Group company
    c. dormakaba USA Inc.
    d. SARGENT Manufacturing Company; ASSA ABLOY
    e. STANLEY; dormakaba USA, Inc.
    f. Yale Security Inc; ASSA ABLOY

B. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305.

C. Rim Exit Devices: Grade 1.

1. Type 1, rim.
2. Actuating Bar: Push pad.
3. Material: Stainless steel.
4. Dogging: Equip panic exit devices with dogging feature.

D. Exit Device Outside Trim: As indicated; full escutcheon, material and finish to match exit device unless otherwise indicated.

2.8 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Cylinders will be installed in Best 7-pin interchangeable cores. Cylinders and cores will be furnished, keyed, and installed by the Owner. Provide hardware compatible with indicated cores.

2.9 OPERATING TRIM

A. Operating Trim: ANSI/BHMA A156.6; stainless steel unless otherwise indicated.

B. Offset Door Pulls: 1-inch constant-diameter pull.

1. Mounting: Through bolted with oval-head machine screws and countersunk washers
2. Offset: 2 inches.
3. Minimum Clearance: 2-1/4 inches from face of door.

2.10 ELECTROMECHANICAL AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Basis of Design Product:

a. Stanley Access Technologies M-Force

2. Acceptable Manufacturers and Products:

a. Horton 4000LE series
b. LCN Senior Swing

B. Requirements:

1. Provide low energy automatic operator units that are electromechanical design complying with ANSI/BHMA A156.19.

a. Opening: Powered by DC motor working through reduction gears.
b. Closing: Spring force.
c. Manual, hydraulic, or chain drive closers are not permitted.
d. Operation: Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Operator will not be damaged by attempt to open a locked door. Provide variable adjustments, including opening and closing speed adjustment.
e. Cover: Aluminum.

2. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 1 to 32 seconds, and logic terminal to interface with accessories, mats, and sensors.
3. Provide drop plates, brackets, and adapters for arms as required to suit opening conditions.
4. Provide motion sensors and/or actuator switches, and receivers for operation as specified.
5. Provide internal auxiliary for interconnection to security system and card reader.
6. Provide key switches, with LED's, recommended and approved by manufacturer of automatic operator as required for function as described in operation

description of hardware sets.

7. Cylinders: Compatible with Best cylinders indicated.
8. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Locate actuators, key switches, and other controls as directed by Architect.

2.11 SURFACE CLOSERS

A. Surface Closers: ANSI/BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Backcheck: Adjustable , effective between 60 and 85 degrees of door opening.

B. Surface Closer with Cover: Grade 1; modern type with mechanism enclosed in cover.

1. Mounting: As indicated.
2. Type: Regular arm.
3. Backcheck: Adjustable, effective between 60 and 85 degrees of door opening.
4. Cover Material: Molded plastic.
5. Closing Power Adjustment: At least 35 percent more than minimum tested value.

2.12 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: ANSI/BHMA A156.16; polished cast-brass, -bronze, or -aluminum base metal.

B. Manual Combination Floor Stop and Holder: Grade 1; 3-1/2 inches long, with holder, keeper, and rubber bumper.

1. Installation: Expansion-shield installation.

C. Wall Bumpers: Grade 1 ; with rubber bumper; 2-1/2-inch diameter, minimum 3/4-inch projection from wall; with backplate for concealed fastener installation.

1. Bumper Configuration: Convex.

2.13 DOOR GASKETING

A. Door Gasketing: ANSI/BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

B. Maximum Air Leakage: When tested in accordance with ASTM E283/E283M with tested pressure differential of 0.3 inch wg, as follows:

1. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
2. Gasketing on Double Doors: 0.50 cfm per ft. of door opening.

C. Rigid, Housed, Perimeter Gasketing: Silicone bulb gasket material held in place by housing; fastened to frame stop with screws.

D. Meeting Astragals for Meeting Stiles: Silicone bulb gasket material held in place by housing; mounted with screws.

1. Housing Material: Aluminum .
2. Mounting: Surface mounted on face of each door.

E. Door Shoes: Neoprene gasket material held in place by housing; mounted to bottom edge of door with screws.

1. Housing Material: Aluminum .
2. Extended Housing: One side of door.
3. Mounting: Surface mounted on bottom edge of door.

2.14 THRESHOLDS

A. Saddle Thresholds:

1. Type: Fluted top.
2. Base Metal: Aluminum.

B. Half-Saddle Thresholds: Fluted-top metal member; and base metal of aluminum .

2.15 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: ANSI/BHMA A156.6; fabricated from 0.050-inch-thickstainless steel ; with manufacturer's standard machine or self-tapping screw fasteners.

B. Armor Plates: 36 inches high by door width with allowance for frame stops.

C. Kick Plates: 8 inches high by door width, with allowance for frame stops.

2.16 AUXILIARY DOOR HARDWARE

A. Auxiliary Door Hardware: ANSI/BHMA A156.16.

B. Silencers for Metal Door Frames: Grade 1; neoprene or rubber; minimum diameter 1/2 inch; fabricated for drilled-in application to frame.

2.17 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Auxiliary Electrified Door Hardware: ANSI/BHMA A156.35.

B. Door Position Switches: Magnetically operated reed switch designed for concealed mounting.

2.18 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and ANSI/BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended; however, aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
3. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.19 FINISHES

A. Provide finishes complying with ANSI/BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine 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 of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.

3.3 INSTALLATION OF DOOR HARDWARE

A. Mounting Heights: 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.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

F. 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 will impede traffic.

G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

H. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 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. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DOOR HARDWARE SCHEDULE

Door Hardware Set 01

Qty	Item	Finish
3	Antifriction Bearing Hinges	630
1	Bored Lock, Function: Storeroom lock	630
1	Rigid, Housed, Perimeter Gasketing	628
1	Door Sweep	628
1	Floor Stop	628
3	Kick Plate	630
1	Saddle Threshold	Mill

Door Hardware Set 02

Qty	Item	Finish
3	Antifriction Bearing Hinges	630
1	Deadbolt for Toilet Doors	626 or 630
1	Offset Pull	626 or 630

1	Electromechanical Automatic Operator	
1	Kick Plate	630

Door Hardware Set 03 (Aluminum Entrance Doors)

Qty	Item	Finish
1	Rim Exit Device, Function: Key + lever entrance	630
1	Rim Exit Device, Function: Storeroom lock, no external lever.	630
1	Offset Pull	626 or 630
1	Electromechanical Automatic Operator	
1	Surface Closer with Cover, Parallel Arm	As specified
1	Electric Strike	630
2	Kick Plate	630
1	Door Position Switch	

Continuous hinges, weatherstripping, and threshold specified in Section 084113

Door Hardware Set 04

Qty	Item	Finish
3	Antifriction Bearing Hinges w/ Security Stud	630
1	Rim Exit Device, Function: Key + lever entrance	630
1	Electromechanical Automatic Operator	
1	Rigid, Housed, Perimeter Gasketing	628
1	Door Sweep	628
1	Armor Plate	630
1	Saddle Threshold	Mill
1	Door Position Switch	

Door Hardware Set 05

Qty	Item	Finish
3	Antifriction Bearing Hinges	630
1	Bored Lockset, Function: Office lock	630
1	Rigid, Housed, Perimeter Gasketing	628
2	Door Sweep	628
1	Wall Bumper	626
1	Kick Plate	630
1	Saddle Threshold	Mill

Door Hardware Set 06

Qty	Item	Finish
3	Antifriction Bearing Hinges w/ Security Stud	630
2	Rim Exit Device, Function: Key + lever entrance	630
1	Surface Closer with Cover, Parallel Arm	As specified
1	Rigid, Housed, Perimeter Gasketing	628
1	Rain Drip	628
2	Door Sweep	628
1	Armor Plate	630
1	Half-Saddle Threshold	Mill

Door Hardware Set 07

Qty	Item	Finish
3	Antifriction Bearing Hinges w/ Security Stud	630

2	Rim Exit Device, Function: Key + lever entrance	630
1	Electromechanical Automatic Operator	
1	Electric Strike	As specified
1	Rigid, Housed, Perimeter Gasketing	628
1	Rain Drip	628
2	Door Sweep	628
1	Armor Plate	630
1	Half-Saddle Threshold	Mill
1	Door Position Switch	

Door Hardware Set 08

Qty	Item	Finish
3	Antifriction Bearing Hinges	630
1	Bored Lock, Function: Storeroom lock	630
1	Door Sweep	628
1	Wall Stop	628
1	Kick Plate	630

END OF SECTION 087111

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SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Monolithic glass.
2. Insulating glass units.
3. Glazing sealants.
4. Glazing tapes.
5. Miscellaneous glazing materials.

1.2 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

1. Insulating glass.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Delegated Design Submittals: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by

qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For fabricated glass, for tests performed by a qualified testing agency.

B. Qualification Statements: For manufacturers of fabricated glass unitsglass testing agency.

C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved by primary glass manufacturer.

B. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.
2. Warranty Period: Five10Insert number years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

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

C. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.

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

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Glass: Obtain tinted and coated glass from single source from single manufacturer.

B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems to withstand normal thermal movement and wind loads without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing to withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:

1. Design Wind Pressures: As indicated on Drawings.

a. Wind Design Data: As indicated on Drawings.

2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
3. Thermal Loads: Design glazing to resist thermal stress breakage induced by

differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
5. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.

2.3 GLASS, GENERAL

A. Glazing Publications: Comply with written instructions of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1 and AAMA TIR A7.
3. IGMA Publication for Insulating Glass: IGMA TM-3000.

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label ofthe SGCC or another certification agency acceptable to authorities having jurisdiction . Label indicates manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.
2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article . Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article . Where fully tempered float glass is

indicated, provide fully tempered float glass.

2.4 MONOLITHIC GLASS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.

C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

D. Low-E-Coated Vision Glass: ASTM C1376.

2.5 INSULATING GLASS UNITS

A. Insulating Glass Unit: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

1. Desiccant: Molecular sieve or silica gel, or a blend of both.

B. Accessories:

1. Perimeter Spacer:

a. Type: [Aluminum with mill or clear anodic finish.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

B. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids

elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC or acrylic foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:

1. Type: EPDM or silicone with Shore A durometer hardness of 85, plus or minus 5.

D. Spacers:

1. Type: Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks:

1. Type: EPDM or silicone with Shore A durometer hardness per manufacturer's written instructions.

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply

with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

    a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch-minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

3.4 INSTALLATION OF GLAZING TAPES

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 INSTALLATION OF GLAZING GASKET (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit

openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.6 INSTALLATION OF GLAZING SEALANT

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 PROTECTION

A. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

B. Remove and replace glass that is damaged during construction period.

3.9 INSULATING GLASS SCHEDULE

A. Low-E-Coated, Tinted Insulating Glass (GL-3):

1. Overall Unit Thickness: 1 inch.
2. Minimum Thickness of Each Glass Lite: 6 mm.
3. Outdoor Lite: Tinted fully tempered float glass.
4. Tint Color: Gray.
5. Interspace Content: Argon.
6. Indoor Lite: Clear, fully tempered float glass.
7. Low-E Coating: Pyrolytic or sputtered on third surface.
8. Winter Nighttime U-Factor: 0.33 maximum.
9. Summer Daytime U-Factor: 0.33 maximum.
10. Visible Light Transmittance: 30 percent minimum.
11. SHGC: 0.35 maximum.
12. Safety glazing required.

B. Insulating Glass Type (GL-4):

1. Overall Unit Thickness: 1 inch.
2. Minimum Thickness of Each Glass Lite: 6 mm.
3. Outdoor Lite: Clear fully tempered float glass.
4. Interspace Content: Air.
5. Indoor Lite: Clear fully tempered float glass.
6. Safety glazing required.

END OF SECTION 088000

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed extruded-aluminum louvers.
2. Blank-off panels.

1.2 DEFINITIONS

A. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).
C. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, and attachment details. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.
D. Delegated Design Submittals: For louvers indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed in accordance with AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Delegated Design Professional Qualifications: For louver design.
C. Sample Warranties: For manufacturer's special warranties.

1.5 QUALITY ASSURANCE

A. Delegated Design Professional Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.
B. Welding Qualifications: Qualify procedures and personnel in accordance with 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."

1.6 WARRANTY

A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, 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 SOURCE LIMITATIONS

A. Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.
B. Structural Performance: Louvers 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 are considered to act normal to the face of the building.

1. Wind Loads:

    a. Determine loads based on pressures as indicated on Drawings.

C. 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 in accordance with AMCA 500-L.

D. 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.

2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Drainable-Blade Louver, Extruded Aluminum:

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. Air Balance; MESTEK, Inc.
    b. Greenheck Fan Corporation
    c. Ruskin; Air Distribution Technologies, Inc.

B. Basis-of-Design Product: Subject to compliance with requirements, provide Greenheck “ESD-435”.

1. Louver Depth: 4 inches.
2. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
3. Mullion Type: Exposed.
4. Louver Performance Ratings:

    a. Free Area: Not less than.8.9 sq. ft. for 48-inch-wide by 48-inch-high louver.
    b. Point of Beginning Water Penetration: Not less than 980 fpm .
    c. Air Performance:

        1) Not more than 0.161-inch wg static pressure drop at 1000-fpm free-area intake velocity.

5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.

2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with stainless steel machine screws, spaced a maximum of 6 inches from each corner and at 16 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached.
2. Finish: Mill finish unless otherwise indicated.
3. Type: Non-rewirable, U-shaped frames.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening, Aluminum: 1/2-inch-square mesh, 0.063-inch diameter wire.

2.5 BLANK-OFF PANELS

A. Uninsulated Blank-Off Panels:

1. Description: Metal sheet attached to back of louver.
2. Aluminum sheet for aluminum louvers, not less than 0.050-inch nominal thickness.
3. Panel Finish: Same finish type applied to louvers, but black color.
4. Attach blank-off panels with sheet metal screws.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209, 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-headhex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless steel fasteners.
3. For exposed surfaces of color-finished louvers, use fasteners with heads that match color of louvers.

D. Joint Sealants and Backings: Provide joint sealants, backings, and other related materials in accordance with Section 079200 "Joint Sealants."

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.7 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.

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 vertical mullions of type and at spacings indicated.

1. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame.

G. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, or threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

A. Finish louvers after assembly.
B. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. 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 OF FIXED LOUVERS

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 on Drawings.

E. Protect unpainted nonferrous-metal surfaces that are in contact with 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, where weathertight louver joints are required. Install joint sealants and backings in accordance with Section 079200 "Joint Sealants."

3.4 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 089119

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstructural steel framing.

B. Related Requirements:

1. Drawing sheet AE301 for structural cold-formed metal framing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Protect materials from corrosion, deformation, and other damage during delivery, storage, and handling in accordance with AISI S202.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Horizontal Deflection: For non-composite wall assemblies, limited to 1/240 of the wall height based on the following horizontal loading:

1. Horizontal Loading: 5 lbf/sq. ft.

2.2 NONSTRUCTURAL STEEL FRAMING

A. Framing Members, General: Comply with requirements in AISI S220 for conditions indicated on Drawings.

1. Protective Coating: ASTM A653/A653M, G40 hot-dip galvanized or coating with demonstrated equivalent corrosion resistance. Galvannealed products are unacceptable.

a. Equivalent Corrosion-Resistant Coating: Evaluation report acceptable to

authorities having jurisdiction demonstrates corrosion resistance equivalent to specified protective coating.

B. Studs and Track: Conventional members, roll-formed into standard shapes without surface deformations to stiffen framing members.

1. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.
2. Minimum Yield Strength: 33 ksi.
3. Depth: As indicated on Drawings.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Power-Actuated Anchors: Fastener systems with an evaluation report, acceptable to authorities having jurisdiction, based on ICC-ES AC70.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, substrates, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF NONSTRUCTURAL STEEL FRAMING, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

3.3 INSTALLATION OF NONSTRUCTURAL STEEL FRAMING

A. Install framing system components at spacings indicated on Drawings, but not greater than spacings required by referenced installation standards for assembly types.

1. Install framing at spacings not less than those required by horizontal deflection performance requirements.

B. Install studs so flanges within framing system point in same direction.

C. Install track at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings . Continue framing around ducts that penetrate partitions above ceiling.

1. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb unless otherwise indicated on Drawings.
b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure unless otherwise indicated on Drawings.

2. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated on Drawings. Install framing below sills of openings to match framing required above door heads.

END OF SECTION 092216

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for nonstructural steel framing and suspension systems that support gypsum board panels.
2. Drawing sheet AE301 for structural cold-formed metal framing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of gypsum board and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide panel products in maximum lengths and widths available that will minimize joints in each area and that correspond with support system specified or indicated on Drawings.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Thickness: As indicated on Drawings.
2. Long Edges: Tapered.

B. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M, tested in accordance with ASTM C1629/C1629M.

1. Core: 5/8 inch, Type X.
2. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
3. Indentation: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
4. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
5. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
6. Long Edges: Tapered.

C. Mold-Resistant Gypsum Board: ASTM C1396/C1396M; manufactured with moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch, Type X.
2. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
3. Long Edges: Tapered.

D. Trim for Interior Gypsum Board: ASTM C1047.

1. Material: Galvanized-steel sheet or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

    a. Cornerbead.
    b. Bullnose bead.
    c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    d. L-Bead: L-shaped; exposed long flange receives joint compound.
    e. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

E. Joint Treatment Materials for Interior Gypsum Board: Comply with ASTM C475/C475M requirements.

1. Joint Tape: Paper.
2. Joint Compound: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

    a. Prefilling: At open joints , rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
    b. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
    c. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
    d. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.

2.4 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C1002 unless otherwise specified or indicated on Drawings.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

C. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF GYPSUM BOARD, GENERAL

A. Comply with ASTM C840 requirements.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form expansion (control) joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.

G. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated on Drawings.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise specified or indicated on Drawings or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated on Drawings or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over studs or furring members and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated on Drawings or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

C. Trim for Interior Gypsum Board: For trim with back flanges intended for fasteners,

attach to framing with same fasteners used for panels. Otherwise, attach trim in accordance with manufacturer's written instructions.

1. Cornerbead: Install at outside corners.
2. Bullnose Bead: Install at outside corners.
3. LC-Bead: Install at exposed panel edges.
4. Expansion (Control) Joint: Install control joints at locations indicated on Drawings.

D. Joint Treatment Materials for Interior Gypsum Board: Treat joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare panel surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

1. Prefill open joints , rounded or beveled edges, and damaged surface areas.
2. Apply joint tape over panel joints, except for trim products specifically indicated as not intended to receive tape.

E. Finish interior gypsum board panels to comply with levels indicated below and in accordance with ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated on Drawings.
2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 099124 "Interior Painting (MPI Standards)."

3.4 PROTECTION

A. Protect adjacent surfaces from joint compound and promptly remove from floors and other non-gypsum board surfaces. Repair surfaces stained, marred, or otherwise damaged during gypsum board installation and finishing.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that have gotten wet, moisture damaged, or 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.

END OF SECTION 092900

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SECTION 099114 - EXTERIOR PAINTING (MPI STANDARDS)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Surface preparation of substrates and application of the following:

1. Exterior paint systems.

B. Paint exposed surfaces of materials listed in “Exterior Painting Schedules” at end of this Section, except where such surfaces are indicated not to be painted.

C. Do not paint prefinished items, finished metal surfaces, and labels.

1. Prefinished items include following factory-finished components:

a. PEMB wall and roof panels and associated trim.
b. PEMB gutters and downspouts.
c. Finished mechanical and electrical equipment.
d. Light fixtures.
e. Snowguards.
f. Sectional overhead doors.

2. Finished metal surfaces include:

a. Anodized aluminum.
b. Stainless steel.
c. Chromium plate.

3. 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.

1.2 DEFINITIONS

A. MPI Gloss Level G4: Between 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, in accordance with ASTM D523.

B. MPI Gloss Level G5: Between 35 to 70 units at 60 degrees, in accordance with ASTM D523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

2. Include preparation requirements and application instructions.
3. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: Not required.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match paint products applied and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint Products: 1 gal. of each material and color applied.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each paint product from single source from single manufacturer.

2.2 EXTERIOR PAINTS, GENERAL

A. MPI Standards: Provide products complying with MPI standards indicated in applicable exterior painting schedule articles and listed in the "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by

topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Steel Substrates: Remove loose rust, loose mill scale, loose shop primer, and other loose foreign matter. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 3.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized metal

by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION OF EXTERIOR PAINT PRODUCTS

A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.
3. Cost of retesting is Contractor's responsibility.

3.5 CLEANING

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 EXTERIOR PAINTING SCHEDULE, METAL SUBSTRATES

A. Steel and Iron Substrates:

1. Water-Based Light Industrial Coating System: MPI EXT 5.1C.

a. Prime Coat: Primer, alkyd, anticorrosive for metal, MPI #79
b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
c. Topcoat: Light industrial coating, exterior, water based semigloss (MPI Gloss Level G5), MPI #163.

B. Galvanized-Metal Substrates:

1. Water-Based Light Industrial Coating System: MPI EXT 5.3K.

a. Prime Coat: Primer, galvanized, water based, MPI #134.
b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
c. Topcoat: Light industrial coating, exterior, water based, semigloss (MPI Gloss Level G5), MPI #163.

END OF SECTION 099114

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SECTION 099124 - INTERIOR PAINTING (MPI STANDARDS)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Surface preparation of interior substrates and application of the following:

1. Interior paint systems.

B. Paint exposed surfaces of materials listed in “Interior Painting Schedules” at end of this Section, except where such surfaces are indicated not to be painted.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include following factory-finished components:

a. Acoustical panel ceilings.
b. Architectural woodwork and casework.
c. Finished mechanical and electrical equipment.
d. Light fixtures.
e. Toilet accessories.
f. Prefinished PEMB metal liner panels.
g. Sectional overhead doors.

2. Concealed surfaces include walls or ceilings in following generally inaccessible spaces:

a. Spaces above acoustical panel ceilings.

3. Finished metal surfaces include:

a. Anodized aluminum.
b. Stainless steel.
c. Chromium plate.

4. Operating parts include moving parts of operating equipment and:

a. Valve and damper operators.
b. Linkages.
c. Sensing devices.
d. Motor and fan shafts.

5. 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.

D. Related Requirements: Section 099114 “Exterior Painting (MPI Standards)” for painting interior sides of exterior hollow metal doors and frames.

1.2 DEFINITIONS

A. MPI Gloss Level G4: Between 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, in accordance with ASTM D523.

B. MPI Gloss Level G5: Between 35 to 70 units at 60 degrees, in accordance with ASTM D523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Include preparation requirements and application instructions.
3. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: Not required.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials that match paint products applied and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint Products: 1 gal of each material and color applied.

1.5 MOCKUPS

A. Apply mockup of water-based concrete floor sealer system to concrete floor in Utility 105 to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Final approval of concrete floor sealer system will be based on mockup.
2. Approval of mockup does not constitute approval of deviations from the Contract Documents contained in mockup unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockup may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each paint product from single source from single manufacturer.

2.2 INTERIOR PAINTS, GENERAL

A. Interior Paint 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. Benjamin Moore & Co.
    b. Pittsburgh Paints Company (The)
    c. Sherwin-Williams Company (The)

B. MPI Standards: Provide products complying with MPI standards indicated in applicable interior painting schedule articles and listed in the "MPI Approved Products List."

C. Material Compatibility:

1. Materials for use within each paint system must be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products must be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

D. Colors: As indicated in a color schedule on Drawings.

1. Where colors are not indicated in color schedule, provide colors selected by Architect from manufacturer’s full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

C. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove loose rust, loose mill scale, loose shop primer, and other loose foreign matter. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 2.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where

shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized Metal Substrates: Remove grease and oil residue from galvanized metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Wood Substrates:

1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for interior use in paint system indicated.
2. Sand surfaces that will be exposed to view and remove sanding dust.
3. Prime edges, ends, faces, undersides, and backsides of wood.

3.3 APPLICATION OF INTERIOR PAINT PRODUCTS

A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

D. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view in occupied spaces:

a. Equipment, including panelboards.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
h. Other items as directed by Architect.

2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.
3. Cost of retesting is Contractor's responsibility.

3.5 CLEANING

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 INTERIOR PAINTING SCHEDULE, CONCRETE SUBSTRATES

A. Horizontal (Traffic) Surfaces:

1. Water-Based Concrete Floor Sealer System: MPI INT 3.2G.

a. First Coat: Sealer, water based, for concrete floors, matching topcoat.
b. Topcoat: Sealer, water based, for concrete floors, MPI #99.

3.8 INTERIOR PAINTING SCHEDULE, METAL SUBSTRATES

A. Steel and Iron Substrates:

1. Water-Based Light Industrial Coating System: MPI INT 5.1B.

    a. Prime Coat: Primer, rust inhibitive, water based, MPI #107.
    b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    c. Topcoat: Light industrial coating, interior, water based, ((MPI Gloss Level G5), MPI #153.

B. Galvanized Metal Substrates:

1. Water-Based Light Industrial Coating System: MPI INT 5.3K .

    a. Prime Coat: Primer, galvanized, water based, MPI #134.
    b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    c. Topcoat: Light industrial coating, interior, water based, (MPI Gloss Level G5), MPI #153.

3.9 INTERIOR PAINTING SCHEDULE, WOOD SUBSTRATES

A. Exposed Wood Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 6.2L .

    a. Prime Coat: Primer, latex, for interior wood, MPI #39.
    b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
    c. Topcoat: Latex, interior, institutional low odor/VOC, MPI Gloss Level G4), MPI #146.

3.10 INTERIOR PAINTING SCHEDULE, GYPSUM-BASED SUBSTRATES

1. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.

    a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
    b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
    c. Topcoat: Latex, interior, institutional low odor/VOC, MPI Gloss Level G4), MPI #146.

END OF SECTION 099124

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SECTION 102800 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.

1.2 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.

B. Samples: For each finish specified.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, visible silver spoilage defects.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Design accessories and fasteners to comply with the following requirements:

1. Grab Bars: Installed units are able to resist 250 lbf minimum concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain each type of public-use washroom accessory from single source from single manufacturer.

B. 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. ASI-American Specialties, Inc.
2. Bobrick Washroom Equipment, Inc
3. Bradley Corporation

2.3 BABY CHANGING STATION

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. ASI-American Specialties, Inc.
2. Koala Kare Products.
3. Rubbermaid Commercial Products.

2.4 MATERIALS

A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch-minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.

C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch-minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer in writing or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.

G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.5 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION OF TOILET, BATH, AND LAUNDRY ACCESSORIES

A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer in writing. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

3.3 CLEANING

A. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800

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SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguishers.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers".

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing semirecessed-mounting method and relationships of box and trim to surrounding construction.

B. Samples for Initial Selection: For each type of exposed finish required.

C. Samples for Verification: Not required.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 FIRE-PROTECTION CABINET

A. Fire-Protection Cabinet Type: Suitable for fire extinguisher.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Cold-rolled steel sheet.

D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

1. Fire Protection Cabinet Type 1: Rolled-Edge Trim: 4-inch backbend depth.
2. Fire Protection Cabinet Type 2: Rolled-Edge Trim: 2 1/2-inch backbend depth.

E. Cabinet Trim Material: Steel sheet.

F. Door Material: Steel sheet.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Tempered float glass (clear).

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide recessed door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

J. Accessories:

1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. .

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door.
2) Application Process: Silk-screened or pressure-sensitive vinyl letters.
3) Lettering Color: White.
4) Orientation: Vertical.

K. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
c. Color: As selected by Architect from manufacturer's full range.

2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Miter corners and grind smooth.
3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are 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 walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF FIRE-PROTECTION CABINETS

A. General: Install fire-protection cabinets in locations and at mounting heights indicated.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification:

1. Apply vinyl lettering at locations indicated.

3.3 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Portable, hand-carried fire extinguishers. Contractor is responsible for furnishing, inspecting, and installing all fire extinguishers indicated in Contract Documents.

B. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test in accordance with NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
b. Faulty operation of valves or release levers.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Hand-Carried Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.

1. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories from single source from single manufacturer.
2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
5. Multipurpose Dry-Chemical Type: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

B. Service Tag: Provide service tag complying with NFPA 10 requirements for each extinguisher.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Designate an experienced person to perform fire extinguisher inspections.
2. Inspect fire extinguishers for compliance with requirements of NFPA 10, “Twelve-Point Monthly Inspection Checklist”.
3. For each extinguisher, record date of inspection and initials of person performing inspection on service tag and attach tag to extinguisher.
4. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF FIRE EXTINGUISHERS

A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION 104416

SECTION 123623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad countertops.
2. Accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings:

1. Plans, sections, details, and attachments to other work.
2. Locations and sizes of cutouts and holes for items installed in countertop.

C. Samples for Initial Selection: Plastic laminates in each type, color, pattern, and surface finish required, in manufacturer's standard size.

D. Samples for Verification: Not required.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of products.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

B. Keep surfaces of countertops covered with protective covering during handling and installation.

1.5 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with ANSI/AWI 1236 for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.

B. Plastic-Laminate-Clad Countertop Type:

1. Grade: Custom.
2. Plastic-Laminate Cladding: High-pressure decorative laminate.
3. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

    a. As indicated by manufacturer's designations.

4. Edge Treatment: Same as laminate cladding on horizontal surfaces.
5. Core Material: Particleboard or MDF Particleboard MDF.
6. Core Material at Sinks: Particleboard made with exterior glue MDF made with exterior glue.

    a. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.
    b. Provide drip groove 1/8 by 1/8 inch set back 3/8 inch. Insert groove size and location from front edge of countertop.

2.2 PLASTIC LAMINATES

A. High-Pressure Decorative Laminate:

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. ABET Inc.
    b. Formica Corporation
    c. Laminart LLC
    d. Nevamar Company, LLC
    e. Wilsonart LLC

2. Standard: ISO 4586-3, Grade HGS.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

B. Composite Panel Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.

1. Composite Wood Products: Verify formaldehyde emission rates are not greater than the following when tested in accordance with ASTM D6007 or ASTM E1333:

a. Particleboard: 0.09 ppm.
b. MDF More Than 5/16 Inch (8 mm) Thick: 0.11 ppm.

2. Medium-Density Fiberboard (MDF): ANSI A208.2 , MR 10.

a. Grade: 130 or better; complying with performance requirements specified.

3. Particleboard: ANSI A208.1 , MR 10 .

a. Grade: M-2 or better; complying with performance requirements specified.

2.4 MISCELLANEOUS MATERIALS

A. Adhesives: Do not use adhesives that contain urea formaldehyde.

B. Adhesive for Bonding Plastic Laminate: Type I, waterproof type as selected by fabricator to comply with requirements.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION

A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets.

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Seal edges of cutouts by saturating with varnish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.3 INSTALLATION OF PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Complete fabrication at Project site to extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
2. Seal edges of cutouts by saturating with varnish.

C. Countertop Installation:

1. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
3. Anchor wall cleating necessary for proper setting for countertops not supported by casework.
4. Install countertops level and true in line. Use concealed shims as required to maintain not more than 1/8-inch-in-96-inch variation from a straight, level plane.
5. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
6. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant.

3.4 ADJUSTING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where impossible to repair, replace countertops. Adjust joinery for uniform appearance.

3.5 CLEANING

A. Clean countertops on exposed and semiexposed surfaces.

3.6 PROTECTION

A. Protection: Provide kraft paper or other suitable covering over countertop surfaces,

taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 123623.13

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SECTION 133419 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal building systems.
2. Structural-steel framing.
3. Metal roof panels.
4. Metal wall panels.
5. Metal soffit panels.
6. Thermal insulation.
7. Accessories.

B. Related Requirements:

1. Section 077253 "Snow Guards" for devices designed to hold snow on the roof surface.
2. Section 083613 "Sectional Doors" for sectional vehicular doors in metal building systems.
3. Section 084113 “Aluminum-Framed Entrances and Storefronts” for aluminum entrance doors and aluminum windows fabricated from storefront framing.

1.2 DEFINITIONS

A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.3 COORDINATION

A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are on the Drawings.

B. Coordinate imposed load of sectional doors, HVAC equipment, high-velocity low-volume fans, electrical equipment, and items specified in other Sections and supported by metal building components.

C. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: By manufacturer of metal building systems. Indicate components by others. Include full building plan, elevations, sections, details, and the following:

1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.
2. Structural-Framing Drawings: Indicate complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
3. Metal Panel Layout Drawings: Indicate roof and wall . layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; indicate locations of exposed fasteners.

a. Indicate wall-mounted items including personnel doors, vehicular doors, windows, louvers, and lighting fixtures.

4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches :

a. Flashing and trim.
b. Gutters.
c. Downspouts.

5. Roof Insulation Liner System: Indicate the following:

a. Liner fabric layout.
b. Insulation layout and cut list.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

D. Samples for Verification: Actual sample of finished products for each type of exposed finish.

1. Metal Roof Panels: Full panel width by 12 inches long. Include fasteners, closures, and other exposed panel accessories.
2. Metal Wall Panels: Full panel width by 12 inches long. Include fasteners, closures, and other exposed panel accessories.
3. Metal Soffit Panels: Full panel width by 12 inches long. Include fasteners,

closures, and other exposed panel accessories.
4. Flashing and Trim: Full panel width by 12 inches long. Include fasteners and other exposed accessories.
5. Vapor-Retarder Facing: Minimum 6-inch-square Samples.
6. Roof Insulation Liner System Facing: Minimum 6-inch-square Samples.
7. Accessories: Samples for each type of accessory.

E. Delegated Design Submittals: For metal building systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

1. Name and location of Project.
2. Order number.
3. Name of manufacturer.
4. Name of Contractor.
5. Building dimensions including width, length, height, and roof slope.
6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
7. Governing building code and year of edition.
8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads.
9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, in accordance with governing building code.
10. Building-Use Category: Indicate category of building use and its effect on load importance factors.

B. Welding Certificates: For shop or field welding.

C. Material Test Reports: For each of the following products, by a qualified testing agency:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Tension-control, high-strength, and bolt-nut-washer assemblies.
4. Shop primers.
5. Nonshrink grout.

D. Source Quality Control Reports: For structural steel.

E. Qualification Statements: For manufacturer, erector, and land surveyor.

F. Delegated Design Professional Qualifications: For metal building systems.

G. Sample Warranties: For specified special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panel finishes.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Accreditation: Manufacturer's facility accredited in accordance with IAS AC472.
2. Engineering Responsibility: Metal building system design and preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in state Insert jurisdiction where Project is located and who is experienced in providing engineering services of the type indicated.

B. Delegated Design Professional Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

C. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

D. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.

E. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M.
2. AWS D1.3/D1.3M.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, 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. Protect foam-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 foam-plastic insulation materials to Project site before installation time.
3. Complete installation and concealment of foam-plastic materials as rapidly as possible in each area of construction.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed in accordance with manufacturers' written installation instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty on Metal Panel Finishes: 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 Hunter units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal building system.

B. Structural Performance: Metal building systems to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated in accordance with procedures in MBMA's "Metal Building Systems Manual":

1. Design Loads: As indicated on Drawings.
2. Deflection and Drift Limits:

    a. Deflection to be no greater than the following:

        1) Main Frame: Vertical deflection of 1/240 of the span.
        2) Purlins and Rafters: Vertical deflection of 1/240 of the span.
        3) Girts: Horizontal deflection of 1/180 of the span.
        4) Metal Roof Panels: Vertical deflection of 1/180 of the span.
        5) Metal Wall Panels: Horizontal deflection of 1/180 of the span.
        6) Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
        7) Lateral Drift: As indicated on the Drawings.

C. Seismic Performance: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces .

E. Structural Performance for Metal Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E1592:

1. Wind Loads: As indicated on Drawings.

F. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.04 cfm/sq. ft when tested in accordance with ASTM E1680 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft.

G. Air Infiltration for Metal Wall Panels: Air leakage of not more than 0.04 cfm/sq. ft. when tested in accordance with ASTM E283/E283M at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft.

H. Water Penetration for Metal Roof Panels: No water penetration when tested in accordance with ASTM E1646 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft.

I. Water Penetration for Metal Wall Panels: No water penetration when tested in accordance with ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft.

J. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 30.
2. Hail Resistance: MH.

K. Thermal Performance for Opaque Elements: Provide the following minimum R-values when tested in accordance with ASTM C1363 or ASTM C518:

1. Roof Insulation Liner System:

    a. R-Values: R-19 + R-11.

2. Walls:

    a. R-Values: R-13 + R-13 continuous insulation.

2.3 METAL BUILDING SYSTEMS

A. Exterior Colors and Profiles: Match colors and profiles of metal roof and wall panels, metal gutters, and metal roof trim on existing Unmanned Systems Laboratory building adjacent to project site. Coordinate with Owner regarding exterior building locations to be used as color references.

B. Metal Building System:

1. System Description: Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
2. Primary-Frame Type:

    a. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
    b. Lean-to: Solid-member structural-framing system, designed to be partially supported by another structure.

3. End-Wall Framing:

    a. Manufacturer's standard, for buildings not required to be expandable, consisting of load-bearing end-wall and corner columns and rafters.

4. Secondary-Frame Type: Manufacturer's standard purlins and flush-framed girts.
5. Eave Height: Manufacturer's standard height, as indicated by nominal height on Drawings.
6. Bay Spacing: As indicated on Drawings.
7. Roof Slope: As indicated on Drawings.
8. Roof System: Manufacturer's standard [standing-seam, vertical-rib metal roof panels.
9. Exterior Wall System: Manufacturer's standard foamed-insulation-core metal wall panels.

a. Liner Panels: Flush profile.

2.4 STRUCTURAL-STEEL FRAMING

A. Structural Steel: Comply with AISC 360.

B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

C. Cold-Formed Steel: Comply with AISI S100 for design requirements and allowable stresses.

D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
3. Frame Configuration: Single gable.
4. Exterior Column: Uniform depth.
5. Rafter: Uniform depth or tapered.

E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:

1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.

F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:

1. Purlins:

a. C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch-wide flanges.

1) Depth: As needed to comply with system performance requirements.

2. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40

to 50 degrees from flange, with minimum 2-1/2-inch-wide flanges.

a. Depth: As indicated on Drawings .

3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch-diameter, cold-formed structural tubing to stiffen primary-frame flanges.
5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
6. Base or Sill Angles: Manufacturer's standard base angle, minimum 3-by-2-inch, fabricated from zinc-coated (galvanized) steel sheet.
7. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
8. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
9. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

G. Canopy Framing: Manufacturer's standard structural-framing system, designed to withstand required loads; fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.

1. Type: Tapered-beam, below-eave type.

H. Bracing: Provide adjustable wind bracing as follows:

1. Rods: ASTM A36/A36M; ASTM A572/A572M, Grade 50; or ASTM A529/A529M, Grade 50; minimum 1/2-inch-diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
2. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
3. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

I. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.

J. Materials:

1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
3. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM

A529/A529M, Grade 50 or 55.

4. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
5. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B or C, structural tubing.
6. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.
7. Metallic-Coated Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G60 coating designation; mill phosphatized.
8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G90 coating designation.
    b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, SS, Grade 50 or 80; with Class AZ50 coating.

9. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hex-head bolts; ASTM A563/A563M carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.

    a. Finish: Plain.

10. High-Strength Bolts, Nuts, and Washers, Grade A325 (Grade A325M): ASTM F3125/F3125M, Type 1, heavy-hex steel structural bolts; ASTM A563/A563M, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

    a. Finish: Plain .

11. Unheaded Anchor Rods: ASTM F1554, Grade 36.

    a. Configuration: Straight.
    b. Nuts: ASTM A563/A563M, heavy- hex carbon steel.
    c. Plate Washers: ASTM A36/A36M carbon steel.
    d. Washers: ASTM F436/F436M, hardened carbon steel.
    e. Finish: Plain.

12. Headed Anchor Rods: ASTM F1554, Grade 36ASTM A307, Grade A .

    a. Configuration: Straight.
    b. Nuts: ASTM A563/A563M, heavy- hex carbon steel.
    c. Plate Washers: ASTM A36/A36M carbon steel.
    d. Washers: ASTM F436/F436M, hardened carbon steel.
    e. Finish: Plain.

13. Threaded Rods: ASTM A36/ .

    a. Nuts: ASTM A563/A563M, heavy- hex carbon steel.
    b. Washers: ASTM F436/F436M, hardened.
    c. Finish: Plain.

K. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.

1. Clean and prepare in accordance with SSPC-SP2.
2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.

    a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2.5 METAL ROOF PANELS

A. Standing-Seam, Vertical-Rib, Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inchnominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Exterior Finish: Two-coat fluoropolymer.
    b. Color: As selected by Architect from manufacturer's full range

2. Clips: One-piece fixed or two-piece floating to accommodate thermal movement.

    a. Provide spacer clips having height recommended by roof insulation liner system manufacturer to accommodate spacer blocks and roof insulation.

3. Joint Type: Mechanically seamed.
4. Panel Coverage: 16 inches .
5. Panel Height: 2 inches.

B. Finishes:

1. Exposed Coil-Coated Finish:

    a. Two-Coat Fluoropolymer: 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.

2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat

with a minimum total dry film thickness of 0.5 mil.

2.6 METAL WALL PANELS

A. Insulated Metal Wall Panels: Formed with tongue-and-groove panel edges; foamed-insulation-core; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.

1. Panel Thermal-Resistance Value (R-Value): R-13 minimum.
2. Facing Material: Fabricate panel with exterior and interior facings of same material and thickness. Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet,0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Exterior Surface: Profile as indicated on Drawings.
    b. Exterior Finish: Two-coat fluoropolymer.
    c. Color: As selected by Architect from manufacturer's full range.

3. Panel Coverage: 36 inches nominal.
4. Panel Thickness:2.5 inches minimum. Increase thickness if required to achieve specified R-value .
5. Insulation Core: Polyurethane foam using a non-CFC blowing agent, foamed-in-place, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.

    a. Closed-Cell Content: 90 percent when tested in accordance with ASTM D6226.
    b. Density: 2.0 to 2.6 lb/cu. ft. when tested in accordance with ASTM D1622.
    c. Compressive Strength: Minimum 20 psi when tested in accordance with ASTM D1621.
    d. Shear Strength: 26 psi when tested in accordance with ASTM C273/C273M.

6. Fire-Test-Response Characteristics: Class A in accordance with ASTM E108.
7. Surface-Burning Characteristics: Flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E84.

B. Finishes:

1. Exposed Coil-Coated Finish:

    a. Two-Coat Fluoropolymer: 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.

2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.7 METAL SOFFIT PANELS

A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Concealed-Fastener, Flush-Profile, Metal Soffit Panels: Formed with vertical panel edges and flush surface ; with flush joint between panels; with 1-inch-wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Exterior Finish: Fluoropolymer.
    b. Color: As selected by Architect from manufacturer's full range.

2. Panel Coverage: 12 inches.
3. Panel Height: 1 inch.

2.8 THERMAL INSULATION TYPES

A. Thermal Insulation for Wall Assemblies:

1. Faced Glass-Fiber-Blanket Insulation: ASTM C991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch-wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
2. Unfaced Glass-Fiber-Blanket Insulation: ASTM C991, Type I, or NAIMA 202, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch-wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.

    a. Nonreflective Faced: Type II (blankets with nonreflective membrane covering), Category 1 (membrane is a vapor retarder), Class A (membrane-faced surface with a flame-spread index of 25 or less).

B. Vapor-Retarder Facing: ASTM C1136, with permeance not greater than 0.02 perm when tested in accordance with ASTM E96/E96M, Desiccant Method.

1. Composition:

    a. White polypropylene or vinyl film facing, fiberglass scrim reinforcement, and metallized-polyester film backing.

C. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.9 ROOF INSULATION LINER SYSTEM

A. Basis of Design Product: Therm-All “ProLiner Banded Liner System”.

1. Provide single-direction banding and liner installation system.

a. At Contractor’s option, bi-directional banding and liner system incorporating fall protection may be provided. Contractor assumes all responsibility for using this system as fall protection.

B. Unfaced Glass-Fiber-Blanket Insulation: ASTM C991 Type 1.

1. Surface Burning Characteristics: Flame Spread Index less than 25 and Smoke Developed Index less than 50 when tested in accordance with ASTM E84.

C. Thermal Spacer Blocks: Extruded or expanded polystyrene, R-value 3.0 minimum, width 3 inches minimum.

D. Fabric Liner Facing/Vapor Barrier: Woven polyethylene fabric coated on both sides with polyethylene.

1. Surface Burning Characteristics: Flame Spread Index of 0 and Smoke Developed Index less than 50 when tested in accordance with ASTM E84.
2. Light Reflectance: 80 percent minimum.
3. Color: White.
4. Accessories: System manufacturer’s recommended vapor barrier adhesive, double-sided tape, patch tape, and insulation hangers.
5. Metal Banding/Straps: Coated steel, width 1 inch, structural steel Grade 50 per ASTM C 653, exposed color to match vapor barrier, gray backing color.

E. Fasteners: Zinc-plated steel fasteners as recommended by system manufacturer. Fastener head color to match vapor barrier.

2.10 DOORS AND FRAMES

A. Swinging Personnel Doors and Frames:

1. As specified in Section 081113 "Hollow Metal Doors and Frames."

2.11 ACCESSORIES

A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

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.

B. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.

1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
2. Opening Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.030-inch nominal uncoated steel thickness, prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
3. Fasteners: Blind fasteners or self-drilling screws with hex washer head.

C. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, sized in accordance with manufacturer's written instructions.

1. Gutter Supports: Fabricated from same material and finish as gutters.
2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.

D. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-ft.- long sections, complete with formed elbows and offsets.

1. Mounting Straps: Fabricated from same material and finish as gutters.

E. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

F. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.

G. Fasteners for Metal Roof Panels:

1. Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
2. Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.

H. Fasteners for Metal Wall Panels:

1. Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws.

I. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.

J. Blind Fasteners: High-strength aluminum or stainless steel rivets.

K. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

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

M. Metal Panel Sealants:

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
2. Joint Sealant: ASTM C920; one part neutral-curing silicone; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.12 FABRICATION

A. General: Design components and field connections required for erection to permit easy assembly.

1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members to be free of cracks, tears, and ruptures.

B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.

C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.

1. Make shop connections by welding or by using high-strength bolts.
2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
5. Shop Priming: Prepare surfaces for shop priming in accordance with SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.

D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other

plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

1. Make shop connections by welding or by using non-high-strength bolts.
2. Shop Priming: Prepare uncoated surfaces for shop priming in accordance with SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.

E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.13 SOURCE QUALITY CONTROL

A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.

1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.

a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed in accordance with Contract requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.

1. Engage land surveyor to perform surveying.

C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare surfaces to be painted in accordance with manufacturer's written instructions for each particular substrate condition.

B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL-STEEL FRAMING

A. Erect metal building system in accordance with manufacturer's written instructions and erection drawings.

B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

C. Set structural framing accurately in locations and to elevations indicated, in accordance with AISC specifications referenced in this Section. Maintain structural stability of frame during erection.

D. Base and Bearing 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. 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.
3. Promptly pack 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 shrinkage-resistant grouts.

E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.

F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

1. Make field connections using high-strength bolts installed in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.

    a. Joint Type: Snug tightened or pretensioned as required by manufacturer.

G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.

1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
2. Locate and space wall girts to suit openings such as doors and windows.
3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.

H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.

1. Tighten rod and cable bracing to avoid sag.
2. Locate interior end-bay bracing only where indicated.

I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 INSTALLATION OF METAL PANELS, GENERAL

A. 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. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate in accordance with equipment manufacturer's written instructions and to comply with details shown.

C. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.

1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.

D. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.

    a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.

2. Install metal panels perpendicular to structural supports unless otherwise indicated.
3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Locate metal panel splices over structural supports with end laps in alignment.
6. Lap metal flashing over metal panels to allow moisture to run over and off the material.

E. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.

1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.

F. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types used in tested assemblies meeting "Performance Requirements" Article.

1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.5 INSTALLATION OF METAL ROOF PANELS

A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.

1. Install ridge caps as metal roof panel work proceeds.
2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.

B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with

concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.

1. Install clips to supports with self-drilling or self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Predrill panels for fasteners.
5. Provide metal closures at peaks rake edges rake walls and each side of ridge and hip caps.

C. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 ft. on slope and location lines and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 INSTALLATION OF METAL WALL PANELS

A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
2. Shim or otherwise plumb substrates receiving metal wall panels.
3. When two rows of metal panels are required, lap panels 4 inches minimum.
4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
5. Rigidly fasten base end of metal wall panels and allow eave end free movement for thermal expansion and contraction. Predrill panels.
6. Flash and seal metal wall panels with weather closures at eaves and rakes, and at perimeter of all openings. Fasten with self-tapping screws.
7. Install screw fasteners in predrilled holes.
8. Install flashing and trim as metal wall panel work proceeds.
9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated on Drawings; if not indicated, as necessary for waterproofing.
10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Insulated Metal Wall Panels: Install insulated metal wall panels on exterior side of girts. Attach panels to supports at each panel joint using concealed clip and fasteners at maximum 42 inches o.c., spaced not more than manufacturer's written instruction. Fully engage tongue and groove of adjacent insulated metal wall panels.

1. Install clips to supports with self-tapping fasteners.
2. Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels as weather seal.

C. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 ft., noncumulative; level, plumb, and on location lines; and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 INSTALLATION OF METAL SOFFIT PANELS

A. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.

B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

3.8 INSTALLATION OF THERMAL INSULATION FOR WALL ASSEMBIES

A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, in accordance with manufacturer's written instructions.

1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces.
2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.

B. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.

3.9 INSTALLATION OF ROOF INSULATION LINER SYSTEM

A. Install liner system in accordance with manufacturer’s installation instructions and approved Shop Drawings.

B. Clean and dry purlin and girt attachment surfaces prior to attaching adhesive tape or sealing adhesives.

C. Install blanket insulation to fit snugly against purlin and girt walls in cavity spaces. Avoid excess compression. Fill gaps and voids with insulation.

3.10 INSTALLATION OF ACCESSORIES

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

B. Flashing and Trim: Comply with performance requirements and manufacturer's written installation instructions. Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 ft. 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).

C. Gutters: Join sections with lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Tie downspouts to underground drainage system indicated.

E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.11 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.

3.12 CLEANING

A. Clean dirt from vapor barrier surfaces using a soft cloth with soap and water or non-abrasive household cleaner. Avoid use of solvent-based cleaners and abrasive pads.

B. Touchup Painting:

1. After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing , bearing plates, and accessories.

a. Clean and prepare surfaces by SSPC-SP 2 or SSPC-SP 3.
b. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

3.13 PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

B. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 133419

SECTION 22 0500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of Division 01, the General Conditions, Supplementary General Conditions, and Special Conditions apply to this and all Plumbing sections.

B. This Section applies to all Division 22 specification sections.

C. Requirements of this section apply to all existing and new work unless otherwise indicated.

1.2 DEFINITIONS

A. The use of the word "PROVIDE" in the specifications and on drawings shall mean: Furnish and install complete supplying all necessary labor and materials.

1.3 GENERAL REQUIREMENTS

A. Furnish all necessary labor, material, and equipment, including materials not specifically mentioned, but necessary to complete the job in a neat, correct and workmanlike manner.

B. The drawings and specifications shall be considered as supplementary, one to the other, so that materials and labor indicated, called for, or implied by the one and not by the other, shall be supplied and installed as though specifically called for by both.

1.4 JOB CONDITIONS

A. The drawings show the general scope and arrangement of the plumbing systems and shall be followed as closely as actual conditions allow.

B. Drawings are diagrammatic and do not indicate all offsets, fittings, and specialties. Examine other drawings, investigate conditions to be encountered, and arrange work accordingly, furnishing all fittings, offsets, etc., required without additional costs.

C. Before construction of project starts, check location and inverts of existing and proposed pipes, sewers, and mains. Review other drawings for project, checking grades, elevations, locations of structural elements, locations and sizes of chases, type and method of construction of floors, walls and partitions. Report to Architect before start of construction any conflicts or unsatisfactory conditions. In no case

shall Contractor proceed in uncertainty. No extra charge will be approved after start of construction for work resulting from failure to follow these instructions.

D. Give consideration to all other trades. Make arrangements to avoid conflicts and interference with other work. Fully coordinate all components of plumbing systems with minor adjustments as required, including provision of offsets, transitions, fittings, and accessories to meet actual conditions.

1.5 ELECTRICAL WORK

A. Plumbing pumps and equipment specified herein shall be provided complete with motors, integral motor starters or VFD's where indicated, and controls.

B. Electrical equipment and wiring shall conform to the requirements of Division 26 - Electrical. Manual or automatic control and protective or signal devices required for the operation specified herein, and any control wiring required for control devices but not shown on the electrical plans shall be provided under this Section.

1.6 CONFORMANCE TO REGULATIONS

A. All work shall conform to the regulations of the applicable federal, state, and local laws, ordinances and codes.

B. Work shall be installed according to local Plumbing Code and shall meet Plumbing Inspector's approval. Local codes shall apply where such codes exceed the requirements of this specification.

C. In absence of codes or authorities, install all work according to the codes the project was permitted under.

1.7 REGULATORY REQUIREMENTS

A. All products shall be listed by Underwriters Laboratories, Inc. (UL), and shall bear the UL label. Where UL labels are not provided from the factory, the contractor shall be responsible for having the equipment or materials tested by a UL testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.8 QUALITY ASSURANCE

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. Work shall meet or exceed minimum recommendations of:

1. AGA - American Gas Association
2. ANSI - American National Standards Institute
3. ASME American Society of Mechanical Engineers
4. ASPE - American Society of Plumbing Engineers
5. ASTM - American Society for Testing and Materials
6. AWS - American Welding Society
7. AWWA - American Water Works Association
8. EPA - Environmental Protection Agency
9. GAMA - Gas Appliance Manufacturer's Association
10. ISA - Instrument Society of America
11. NEMA - National Electrical Manufacturers Association
12. NFPA - National Fire Protection Association
13. NIOSH - National Institute for Occupational Safety and Health
14. NSF - National Sanitation Foundation
15. OSHA - Occupational Safety and Health Act
16. TIMA - Thermal Insulation Manufacturers Association
17. UL - Underwriters' Laboratories
18. USDOE - United States Department of Energy

C. Reference to the standards of any technical society, organization, or association, or to the laws, ordinances, or codes of governmental authorities shall mean the latest standard, code, or specification adopted, published, and effective at the date of taking bids.

D. The specifications, codes, and standards referenced in these specifications (including addenda, amendments, and errata) shall govern in all cases where references thereto are made. In case of conflict between the referenced

specifications, the more stringent requirement shall govern unless otherwise permitted by the Architect/Engineer. Major conflicts shall be referred to the Architect/Engineer for resolution.

1.9 PERMITS, LICENSES, AND FEES

A. General Contractor shall obtain and pay for all permits, licenses, fees, and service charges required for the execution of this work. This includes all water and sewer taps required to provide a complete and operational system.

1.10 MATERIALS AND EQUIPMENT

A. Unless specifically provided otherwise, all materials and equipment furnished for permanent installation in the Work shall conform to applicable standards and be new, current design, unused, undamaged, and free from flaws and defects of any nature.

B. Individual parts shall be manufactured to standard sizes and gauges so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate equipment shall be interchangeable.

C. All work shall be performed by skilled mechanics under competent supervision, employing latest and best practices of the trade.

1.11 UTILITIES AND CONNECTIONS

A. Verify the location of all existing utilities before laying out and making connections. Report any inconsistencies to Architect/Engineer before commencing work. Contractor shall be responsible for any error resulting from failure to exercise these precautions.

B. Connect to the site domestic water supply and sanitary sewer at the locations approximately 5’ outside of the building as indicated on the drawings. Coordinate connection and field verify exact locations and inverts with Site Utility Contractor.

C. Connect to the site gas service beyond the utility provided meter and service regulator outside of the building as indicated on the drawings. Coordinate connection and field verify exact locations and inverts with Site Utility Contractor.

1.12 WIRING DIAGRAMS

A. All plumbing equipment shall be provided with complete wiring diagrams showing all power and control connections. The diagrams shall be placed in a clear plastic pouch that is permanently affixed to the equipment.

1.13 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Refer to Division 01 requirements.

B. Protect products from damage, marring, and soiling.

C. Maintain upon premises, where directed, a storage area, and be responsible for all contents within these areas. Provide all security measures necessary for this area.

D. Area shall be maintained and shall be returned to original condition at the completion of the project.

E. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.

2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.

F. Provide walk-off mats at entries and replace them at regular intervals.

G. Construct dust partitions, where indicated on the drawings or as required.

H. Seal off all return air registers and other mechanical systems to prevent dust from entering.

I. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.

2. Protect finished work from damage, defacement, staining, or scratching.

3. Protect finishes from cleaning agents, or grinding and finishing equipment.

4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings, and protective enclosures.

5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

J. Repair all damage or soiling to the complete satisfaction of the Architect/Engineer; replace any materials or work damaged to such an extent that they cannot be restored to their original factory finish condition, all at no addition to the Contract Sum.

K. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers. Store plastics, other materials, and products subject to damage from heat or cold at the manufacturer’s recommended temperatures.

2. All equipment shall be covered during shipping and wrapped prior to leaving the factory.

L. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.14 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. General: The Contractor shall submit information for Architect/Engineer's review, to demonstrate compliance of the proposed Products and/or installations with the Contract Documents. This information shall include, but not be limited to: catalog data; performance data; noise levels, etc. Proposed Products that are not in compliance with the Contract Documents may be rejected. Information must be submitted on all required Products, including proposed Products that appear to be in compliance with the Contract Documents.

C. Contractor preparation:

1. The Contractor shall review and approve each submittal and coordinate all other related or affected Work before submitting for review. All copies of each submittal shall bear the Contractor's stamp, with signature or initials, certifying review and approval; verification of field dimensions; and coordination with adjacent Work are in compliance with the requirements of the Contract Documents.

2. The Contractor shall identify variations from the requirements of the Contract Documents on all copies of applicable submittals. No extra charges shall be paid for the providing of Products or furnishing of Work required as a result of failure to comply with this requirement.

D. Submittal Format:

1. All submittals, except for samples, shall be submitted electronically.

2. Each submittal shall be accompanied by a letter of transmittal listing Project Title, Contractor, Subcontractor or supplier, submitted Products, pertinent drawing and detail number, and specification section number, as appropriate.

3. Product data shall be clearly marked to identify the applicable Products or models. Options or modifications required by the Contract Documents shall be clearly identified.

4. Submittals shall be complete with all associated Products. Submittals on portions of a Product or system shall not be reviewed.

5. Provide Manufacturer's start-up procedures, testing and checklists.

6. Contractor shall provide coordinated shop drawings of Division 22 systems. Shop drawings shall be prepared in electronic format and submitted in electronic and printed form.

E. Architect/Engineer Procedures: Submittals will be reviewed with reasonable promptness. The Contractor shall allow 15 days for review of each submittal. The Architect/Engineer's comments will be indicated on a Submittal Review Comments form, which will be attached to each copy of the submittal. The contractor shall be responsible for distributing copies of reviewed submittals as appropriate.

F. Resubmission: Contractor shall change or correct submittals as required by the Architect/Engineer and resubmit until approved. The Contractor shall identify any changes other than those required by the Architect/Engineer on all copies of the resubmittal.

G. Approval required: The ordering, fabrication and/or installation of Products before approval of all relevant submittals shall be at the Contractor's risk. Any damage to new or existing Work resulting from the installation of unapproved Products shall be repaired or replaced by the Contractor at no additional cost. Payment will not be recommended for any Work that does not have an approved submittal.

1.15 SUBSTITUTIONS

A. Refer to Division 01 requirements.

B. Requests for written approval to substitute materials or equipment considered by the Contractor as equal to those specified shall be submitted for approval to the

Architect ten days before bids are taken. Requests shall be accompanied by samples, descriptive literature, and engineering information, as necessary to fully identify and appraise the product. No increase in contract sum will be considered when requests are not approved. If the item is found to be equal, the Architect will issue an Addendum making it a part of the Contract Documents prior to bidding. After bidding, no further changes will be considered.

C. Plumbing Contractor shall be responsible for determining that all products submitted for approval meet given space limitations and maintain all required clearances for proper access and service.

D. For a Product specified by naming one or more manufacturers and model, and followed with the statement “or approved equal,” the Contractor may submit a Product other than the Product specified by manufacturer and model, that Product shall be considered a Substitute Product and shall comply with the following conditions:

1. The Contractor shall verify the Substitute Product is equal or superior in all respects to the Specified Product.

2. The Contractor shall submit data on the Substitute Product in compliance with the “Submittals” paragraph herein.

3. After the Substitute Product has been approved by the Architect/Engineer, the Contractor shall be responsible for coordinating the installation of the Substitute Product with all trades. The Contractor shall be responsible for any changes required to incorporate the Substitute Product into the Work.

4. The Contractor waives all claims for additional costs related to the Substitute Product that becomes apparent before, during or after installation.

1.16 OPERATING AND MAINTENANCE MANUAL

A. Refer to Division 01 requirements.

B. General: The Contractor shall submit one electronic copy of the Operation and Maintenance Manual to the Architect/Engineer for review a minimum of 60 days prior to Instruction and Training Sessions. This copy will be returned to the Contractor with Architect/Engineer's comments or approval. The Contractor shall revise and resubmit one copy of the O&M Manual as required. The Contractor shall provide four copies of the approved O&M Manual. Instruction and Training Sessions shall begin 30 days after receipt of the approved O&M Manuals. Refer to “Instruction and Training Sessions” paragraph herein.

C. Laminated Asset Schedules: documents including, but not limited to, the following:

1. Equipment Log: Provide a comprehensive log for all plumbing equipment provided for the project. The plumbing equipment log shall identify the following in an 8.5 x 11 landscape format:
   a. Unit ID or designation or mark number.
   b. Equipment manufacturer.
   c. Manufacturer’s model number.
   d. Serial number.
   e. Equipment location.
   f. Location of area(s) served.
   g. Electrical data (voltage, phase, HZ, motor HP, etc.).
   h. Equipment capacity.
   i. Filter sizes, where applicable.
   j. Additional information, as requested by the Owner.
   k. Sample Equipment Log below for reference: As shown similar to the SD report.

Unit ID (Mark)	MFR	Model Number	Serial Number	Eqpt Location	Service Location	Volts-Phase	FLA A	Capacity kW/HP	Flow GPM @SP	Notes
AC-1						120V-1PH	#.# A	#/# HP		
DWH-1				Mech X	Area X	240V-3PH	#.# A	## kW	### GPM	

2. Lubrication Chart: Prepare lubrication charts for each piece of plumbing equipment that requires grease or oil.
   a. Types of lubricants required.
   b. Locations of lubrication points.
   c. Frequency of lubrication.

3. Provide one extra set of lubrication chart mounted in plastic covers, besides those required in Operating and Maintenance Manuals at each mechanical room and/or closet.

D. Electronic Binders:

1. Binders shall be electronic, in portable document file (PDF) format.

2. The first page in each binder shall state, in large font (36 minimum), '[PROJECT NAME] OPERATION AND MAINTENANCE MANUAL; and applicable volume number."

3. Provide a table of contents for each volume and the entire manual and insert at the front of each binder.

4. Provide tabbed bookmarks for each Product and system, with typed description or applicable specification section.

E. Contents: The manual shall consist of three parts as follows:

1. Part 1: Directory listing names, addresses, and telephone numbers of Architect, Engineer, Contractor, Subcontractors, and major equipment suppliers.

2. Part 2: Operation and maintenance instructions including, but not limited to, the following:
   a. General description and specifications of each component and of each system as a whole.
   b. Manufacturer's catalog description of each component supplemented by approved equipment submittals.
   c. Detailed electrical and logic descriptions.
   d. Installation and start-up instructions, including complete calibration procedures for each component and for system as a whole.
   e. Operating instructions including:
      1) Sequence of operation
      2) Shutdown procedure
      3) Emergency operating procedures
   f. Trouble shooting guide with service instructions.
   g. Maintenance instructions for plumbing equipment and systems.
   h. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
   i. Preventive maintenance schedules.
   j. Parts list with names, addresses, and telephone numbers of local parts suppliers.
   k. Names, addresses, and phone numbers of nearest service organizations
   l. Interface requirements and capabilities.
   m. Detailed schematics of equipment.
   n. Complete equipment schedules.
   o. Valve charts, including locations of flow fittings.

3. Part 3: Project documents including, but not limited to, the following:
   a. Testing, adjusting, and balancing report.
   b. Certificates.

c. Copies of warranties and gaurantees.
d. Test reports: Copies of the results of all tests required under all sections of specifications.

F. Quality: The manual will be reviewed by the Architect/Engineer to determine accuracy, completeness and quality of printing. Deficiencies will necessitate resubmittals by the Contractor. Refer to “Submittals” paragraph herein.

1.17 INSTRUCTION AND TRAINING SESSIONS

A. Refer to Division 01 requirements.

B. After all equipment and services are in operation and receipt of the approved Operation and Maintenance Manuals, Instruction and Training Sessions shall be conducted for representatives of the Owner.

C. Instruction Session shall be conducted during the Owner's normal working periods and at times satisfactory to the Owner.

1. Session shall be sufficient to address all aspects of instruction and training for the installed systems, and shall last not less than one 8-hour working day.

D. The Training Session shall address the operation and maintenance of each piece of equipment and of the system as a whole. Preventative maintenance techniques shall be included.

E. Instructions and training shall be given by competent, factory-trained service and operating personnel from the appropriate manufacturer(s). The Contractor shall record the names of all personnel present at each Instruction and Training Session and shall forward a copy of the attendance log to the Architect/Engineer within seven days after each session.

1.18 RECORD DRAWINGS

A. Refer to Division 01 requirements.

B. Maintain on-site one set of the following record documents; record actual revisions to the work of this division:

1. Contract drawings.

2. As-Builts Record documents and shop drawings: Legibly mark each item to record actual construction, including:

a. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
b. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
c. Field changes of dimension and detail.
d. Details not on original Contract Drawings.

3. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:
a. Manufacturer's name and product model and number
b. Product options, substitutions, or alternates utilized
c. Changes made by addenda and modifications

4. Addenda.

5. Change orders and other modifications to the Contract

6. Reviewed shop drawings, product data, and samples

C. Maintain record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Submit documents as specified in Division 01.

1.19 PROJECT/SITE CONDITIONS

A. Install work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing the proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission from the Architect/Engineer before proceeding.

C. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the Owner and Architect in writing.

2. Do not perform any work that would disturb the suspected material until written instructions have been received.

1.20 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.21 WARRANTIES

A. Refer to Division 01 requirements.

B. All work and equipment provided as work of this division shall be fully warranted under the general project warranty, which shall include a 2-year/24 hour/7 day full parts and labor warranty for all plumbing work and equipment. In addition, provide added special warranties specified in individual sections.

C. During the correction period, the Contractor shall begin correcting any work found to be not in accordance with the requirements of the Contract Documents within 4-hours of receiving written notice from the Owner. Provide a detailed schedule for completion of work within 24-hours of receiving written notice from the Owner and revise the schedule based on any Owner comments generated. Except as otherwise required in General Conditions and Division 01, the correction period is two years after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

1. Provide a service log on all equipment repairs to the Owner at the end of the warranty period.

D. Provide copies of manufacturer warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

E. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers' standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

F. Warranty periods shall begin from the Date of Substantial Completion.

1. When the use of the permanent equipment has been permitted for temporary use or occupancy of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

G. The contractor shall complete the manufacturer product registration forms in the Owner's name.

H. Contractor and Installer Warranty:

1. To correct defects in workmanship, materials, equipment, and operation of the system for a period of one year from the date of acceptance. Equipment and materials repaired or replaced are guaranteed for one year following the date of correction.

2. To remove any item not specified or given approval and replace it with a specified item.

3. Any item submitted for approval that does not conform to these specifications shall have an accompanying note of exception.

4. That the system as installed shall comply with code requirements.

5. To repair any damage to building and equipment resulting from defects in workmanship, new materials, new equipment, and system operation.

6. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.22 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA).

B. Contractor's and subcontractors' responsibilities are described in Division 01. Refer to Division 01 requirements.

C. Start-up of all systems and sub-systems shall be coordinated by the Commissioning Agent. An experienced mechanic(s) shall be on site throughout the start-up and commissioning process to coordinate activities and insure that all equipment is functioning as intended.

D. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

1.23 CONTRACTOR COORDINATION

A. Nomenclature for final room names and numbers may vary from the construction documents. Final names and numbers used in the shop drawings shall be coordinated with final room names and numbers assigned by the Owner and Architect.

B. Plumbing contractor(s) shall coordinate their work with all other trades prior to fabrication of systems and commencement of installation. It shall be the responsibility of each contractor to review the work of other trades (including, but not limited to civil, structural, architectural, food service, special equipment, fire alarm, fire suppression, HVAC, and electrical) as it affects their work, and as their work affects other trades, to insure that the construction documents are closely followed. Where discrepancies arise, they shall be referred to the Architect/Engineer for resolution before proceeding with the Work.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Unless otherwise noted, install equipment in accordance with manufacturer's printed instructions for application indicated.

B. Install, operate, and adjust systems in accordance with the plans and specifications.

C. All work for this division shall conform to the regulations of the applicable federal, state, and local laws, ordinances, and codes.

D. A Request For Information (RFI) shall be submitted to the Architect/Engineer for any portion of the Work that the Contractor determines a clarification is required. Prior to submitting a RFI the Contractor shall thoroughly research the Contract Documents to ensure information has not been overlooked. The RFI shall include references to the portion of the Contract Documents that requires a clarification. The Contractor shall allow a minimum of three business days for the Architect/Engineer to respond to the RFI. The Contractor shall not proceed with that portion of the Work until a response has been returned.

E. All Products delivered to the site(s) shall be stored in accordance with the manufacturer's printed instructions. If a manufacturer does not have printed instructions then the Product shall be adequately housed and otherwise protected against damage or corrosion. If any Product stored at the site(s) is not protected as specified herein, the Contractor shall not receive payment for that Product. Any Product damaged as a result of failure to comply with this requirement shall be replaced by the Contractor at no additional cost to the Owner.

3.2 CUTTING AND PATCHING

A. Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of pipes, ducts and appurtenances. Close superfluous openings and remove all debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the Architect.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and all materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.3 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.4 ACCESSIBILITY

A. Locate all equipment, which must be serviced, operated, or maintained in fully accessible positions in accordance with manufacturer's recommendations and subject to approval of Architect. Provide a minimum of two feet of clearance in front of equipment access doors and components requiring service.

B. All materials and equipment shall conform to the space limitations. Maintain maximum headroom and space clearances at all points.

3.5 FIRESTOPPING

A. Refer to Division 07 requirements.

B. For all penetrations or openings in or through fire-rated assemblies including, but not limited to, walls, floors, ceilings, shafts, etc. the Contractor will provide approved UL listed "through penetration firestop" systems to ensure integrity of rated assembly. Refer to architectural drawings and details for approved options and confirm final selection with Architect/Engineer before proceeding with this portion of the Work.

3.6 PROTECTION OF OPENINGS

A. Openings in partially installed systems, including equipment and piping, shall be plugged, capped, or otherwise closed with approved methods and materials or devices until connections are made.

3.7 PROTECTION FROM MOVING PARTS

A. Belts, shafts, couplings, and other rotating or moving parts, located so that any person may come in proximity thereto, shall be fully enclosed or properly guarded.

3.8 PROTECTION OF FIXTURES, EQUIPMENT, AND MATERIALS

A. Protect all fixtures and equipment against damage of any nature. During construction, pipe openings, drains, etc. shall be protected with plugs or caps. No fixtures shall be used during construction.

3.9 CLEANING

A. Prior to acceptance of the building, thoroughly clean all exposed portions of the plumbing installation, removing all labels and all traces of foreign substances, using a cleaning solution approved by the manufacturer of the plumbing item, and being careful to avoid all damage to the finished surfaces.

3.10 COMMISSIONING

A. Comply with requirements of "Commissioning" in Part 1 above.

END OF SECTION 22 0500

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SECTION 22 0517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe sleeves.

B. Pipe sleeve-seals.

C. Escutcheons.

1.2 RELATED REQUIREMENTS

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

B. Section 07 8400 - Firestopping.

C. Section 22 0523 - General-Duty Valves for Plumbing Piping.

D. Section 22 0553 - Identification for Plumbing Piping and Equipment.

E. Section 22 0719 - Plumbing Piping Insulation.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2024.

C. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.

1.4 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. See Section 01 3000 - Administrative Requirements for submittal procedures.

C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

1.5 CLOSEOUT SUBMITTALS

1.6 QUALITY ASSURANCE

A. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.8 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PIPE SLEEVES

A. Manufacturers:

1. Advance Products & Systems, LLC.; Pipe Wall Sleeve : www.apsonline.com/#sle.

2. CCI Piping Systems; Pipe Wall Sleeve : www.ccipipe.com/#sle.

3. Flexicraft Industries; Pipe Wall Sleeve: www.flexicraft.com/#sle.

4. Garlock; Pipe Wall Sleeve: www.garlock.com/#sle.

5. Hilti USA; CFS-CID : www.hilti.com/#sle.

6. Holdrite; Hydroflame : www.holdrite.com/us/en/

7. Metraflex; Pipe Wall Sleeve : www.metraflex.com/#sle.

B. Vertical Pipe Sleeves:

1. Plastic or Galvanized sheet metal sleeve, flush with finished floor.

2. Provide UL listed silicone sealant for watertight joint.

3. Provide UL listed intumescent sealant if required to maintain indicated fire & smoke rating, refer to Division 07 and sealant manufacturer requirements.

C. Pipe Passing Through Below Grade Exterior Walls:

1. Plastic or Enamel coated steel sleeve with 2" wide anchor flange/water stop continuously welded, both sides, all around sleeve.

2. Provide watertight space with link rubber or modular seal between sleeve and pipe on building interior side both pipe ends.

D. Pipe Passing Through Interior Drywall Wall Partitions:

1. Plastic or Galvanized sheet metal sleeve, flush with finished wall surface.

2. In Mechanical, Laundry, or Utility Space, extend 1" beyond finished wall surface.

3. Provide wall escutcheon where exposed in finished space.

4. No wall escutcheon required in utility spaces.

E. Pipe Passing Through Interior Masonry Walls:

1. Plastic or Enamel coated steel sleeve, flush with finished wall surface.

2. In Mechanical, Laundry, or Utility Space, extend 1" beyond finished wall surface.

3. Provide wall escutcheon where exposed in finished space.

4. No wall escutcheon required in utility spaces.

F. Penetrations though structural elements are prohibited without prior approval from the Architect.

G. Clearances:

1. Center source pipe through pipe sleeve.

2. Provide allowance between wall sleeve and source pipe for insulation. Pipe insulation shall NOT be reduced thru wall sleeve. Fill annular gaps each side of sleeve with noncombustible sealant in non-rated walls. Refer to Contract Documents for required pipe insualtion thicknesses.

3. Wall, Floor, Partitions, and Beam Flanges: 1 inch (minimum) greater than outside pipe diameter (including insulation where required).

4. Non-Rated Openings: Caulked tight with noncombustible material.

5. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section to prevent the spread of fire, smoke, and gases.

2.2 PIPE-SLEEVE SEALS

A. Manufacturers:

1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.

2. American Polywater Corporation; PGKD Modular Seals: www.polywater-haufftechnik.com/#sle.

3. CCI Piping Systems; Wrap-It Link : www.ccipipe.com/#sle.

4. Flexicraft Industries; PipeSeal: www.flexicraft.com/#sle.

5. Garlock; Link-Seal: www.garlock.com/#sle.

6. The Metraflex Company; MetraSeal: www.metraflex.com/#sle.

B. Modular Mechanical Sleeve-Seal:

1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.

2. Watertight seal between pipe and wall-sleeve, wall or casing opening.

3. Size and select seal component materials in accordance with service requirements.

4. Service Requirements:
   a. Corrosion resistant.
   b. Oil, fuel, gas, and solvent resistant.

c. Underground, buried, and wet conditions.

5. Glass-reinforced plastic pressure end plates.

C. Sealing Compounds:

1. Provide packing and sealing compound to fill pipe to sleeve thickness.

2. Combined packing and sealing compounding to match partition fire-resistance hourly rating.

2.3 ESCUTCHEONS

A. Furnish and install chrome plated floor and ceiling plates where pipes pass through walls, floors, and ceilings in exposed areas.

B. All split ring escutcheons shall be secured to wall with screws aligned horizontally for a neat and permanent installation.

C. All slip-on type escutcheons shall be tight and secure to finished wall.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

3.2 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

E. Structural Considerations: Do not penetrate building structural members unless indicated.

F. Provide sleeves when penetrating floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

1. Whenever pipes pass through masonry walls, floors, and partitions, furnish and install cast iron pipe sleeves of sufficient size to allow bare pipes, or pipes plus insulation if applicable, to pass through easily.

2. Underground Piping: Caulk pipe sleeve watertight with lead free compound mechanically expandable chloroprene inserts with bitumen sealed metal components.

3. Aboveground Piping:
   a. Pack solid using mineral fiber complying with ASTM C592.
   b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.

4. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases sealed in compliance with U.L. regulations.

5. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

G. Manufactured Sleeve-Seal Systems:

1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.

2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.

3. Locate piping in center of sleeve or penetration.

4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.

5. Tighten bolting for a water-tight seal.

6. Install in accordance with manufacturer's recommendations.

H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

I. Escutcheons:

1. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

2. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

3. Escutcheons for Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern, stamped steel with polished, chrome plated finish. One-piece, deep pattern, stamped steel with chrome plated finish.
   b. Bare Piping at Wall, Floor, or Ceiling Penetrations in Finished Spaces: One-piece, stamped steel with polished, chrome plated finish.
   c. Piping at Wall, Floor, or Ceiling Penetrations in Finished Spaces: One-piece, stamped steel with polished, chrome plated finish.
   d. Piping in Unfinished Spaces and Equipment Rooms: Split casting, stamped steel with polished, chrome plated finish.

3.3 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 22 0517

SECTION 22 0519 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water meters.

B. Flow meters.

C. Pressure gauges.

D. Thermometers.

E. Pressure-temperature test plugs.

1.2 RELATED REQUIREMENTS

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

1.3 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2025).

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).

D. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2024.

E. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service; 2024.

F. AWWA C707 - Encoder-Type Remote-Registration Systems for Cold-Water Meters; 2022.

G. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).

H. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

I. NSF 61 - Drinking Water System Components - Health Effects; 2025, with Addendum

J. NSF 372 - Drinking Water System Components - Lead Content; 2024.

K. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Utility Service Metering: Coordinate and apply Utility Service Provider requirements in terms of meter type, size, physical location, pipe size, upstream/downstream pipe lengths required, and other installation details.

1.5 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide red-marked product data sheets for each furnished item with associated components and accessories.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and instrumentation.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

PART 2 - PRODUCTS

2.1 WATER METERS

A. Positive-displacement Water Meters:

1. Manufacturers:
   a. Badger Meter, Inc; Recordall Series: www.badgermeter.com/#sle.
   b. Mueller Systems; 500 Series: https://muellersystems.com/#sle.
   c. Neptune Technology Group; T-10 Series: https://www.neptunetg.com/#sle.
   d. Niagara Meters: www.niagarameters.com/#sle.
   e. Sensus, a Xylem brand; SR II Series: www.sensus.com/#sle.
   f. Zenner USA; _____: www.zennerusa.com/#sle.

2. Utility Connection Size: As indicated on drawings .

3. Maximum Unidirectional Water Flow Capacity: As indicated on drawings.

4. Local Monitoring: HR-LCD scale register for digital local readout.

5. Lead-free bronze alloy case and cap with hermetically-sealed mechanical register.

6. Pressure and Temperature: Up to 150 psi and 100 degrees F.

7. AWWA C700, with lead content below 0.25 percent when using non-lead-free materials on wetted surfaces according to NSF 61 and NSF 372.

B. Turbine Water Meters:

1. Manufacturers:
   a. Badger Meter, Inc: www.badgermeter.com/#sle.
   b. Niagara Meters: www.niagarameters.com/#sle.
   c. Onicon, Inc: www.onicon.com/#sle.
   d. Sensus, a Xylem brand: www.sensus.com/#sle.
   e. Zenner USA:
   f. Substitutions: See Section 01 6000 - Product Requirements.

2. Inline Type: Class 150 flanged, sweat, or threaded.

3. Insertion Type: Include ball valve and threadolet.

4. Meter Size: ___ inch.

5. Flow Capacity Range: As indicated on drawings.

6. Remote Monitoring: AWWA C707 digital-register with wireless AMI interface.

7. Coated ductile iron case, polymer-based cap, test port, and hermetically sealed register with low flow indicator.

8. Pressure and Temperature: Up to 175 psi and 120 degrees F.

9. AWWA C701 Class II, with lead content below 0.25 percent when using non-lead-free materials on wetted surfaces according to NSF 61 and NSF 372.

10. Accessories: Provide downstream PT test plug and sight flow indicator.

C. Ultrasonic Water Meters:

1. Manufacturers:

a. Badger Meter: www.badgermeter.com/#sle.
b. Badger Meter, Inc: www.badgermeter.com/#sle.
c. Onicon, Inc; F-4300: www.onicon.com/#sle.
d. Rosemount, a brand of Emerson Electric Co: www.emerson.com/#sle.
e. Siemens USA: www.siemens.com/#sle.
f. Sierra Instruments, Inc: www.sierrainstruments.com/#sle.
g. Substitutions: See Section 01 6000 - Product Requirements.

2. Inline Type:
   a. Copper, stainless steel, or aluminum pipe segment with wetted transducing sensors.
   b. Meter Size: ___ inch.
   c. Accuracy: One percent of value applied to manufacturer specified velocity range.
   d. Service Pressure and Temperature: Up to 400 psi and 32 to 250 degrees F liquid side, 130 degrees F ambient.
   e. Products:
      1) Badger Meter; E-series: www.badgermeter.com/#sle.
      2) Substitutions: See Section 01 6000 - Product Requirements.

   Enclosure Construction: NEMA EN 10250 Type 4 or 4X enclosure with backlit numeric display for consumption reading.

3. Output: Two-wire, 4 to 20 mA, non-loop powered.

2.2 PRESSURE GAUGES

A. Manufacturers:

1. Ashcroft, Inc; 1009: www.ashcroft.com/#sle.

2. Dwyer Instruments, Inc; SGZ: www.dwyer-inst.com/#sle.

3. FNW: www.fnw.com/#sle.

4. Moeller Instrument Company, Inc; Mechanical Contractors Gauge: www.moellerinstrument.com/#sle.

5. Omega Engineering a subsidiary of Spectris, Plc; [_____]: www.omega.com/#sle.

6. Weksler Glass Thermometer Corp; EA14: www.wekslerglass.com/#sle.

7. Winters Instruments: www.winters.com/#sle.

8. Substitutions: See Section 01 6000 - Product Requirements.

B. Pressure Gages: ASME B40.100, cast aluminum case, brass tube and socket, brass movement, adjustable pointer, black scale on white background, needle valve, pulsation damper, straight coil syphon tube.

1. Size: 4-1/2 inch diameter.

2. Accuracy: ASME B40.100, adjustable commercial grade (D) with 5 percent of span.

3. Scale: Psi.

4. Gauge Wetted Materials: Painted steel case and brass socket rated to match process pressure and temperature range.

5. Comply with UL 393 when used for fire protection service or UL 404 when used for compressed gas service.

C. Diaphragm Actuated for Gases:

1. Dial Size and Cover: 3-1/2 inch diameter scale with polycarbonate window.

2. Dial Text and Markings: Black color on white background with scaled cm (cm wg) and inch (in wg) units.

3. Accuracy: ASME B40.100, adjustable commercial grade (B) with 2 percent at mid-range of span.

4. Process Connection: Lower-back, 1/4 inch NPT male except where noted.

5. Gauge Wetted Materials: Painted steel case and phosphor bronze socket rated to match process pressure and temperature range.

6. Comply with UL 404 when used for compressed gas service.

D. Accessories:

1. Air or Gas Sensor: Static pressure with compression fittings for bulkhead mounting and 1/4 inch diameter tubing.

2. Gauge Cock: Carbon steel with tee or lever handle for maximum 150 psi.

3. Needle Valve: Carbon steel, 1/4 inch NPT female for noncorrosive service.

4. Coil Siphon: 213 seamless steel, 1/4 inch NPT male for rated capacity.

5. Pressure Snubber (Pulsation Damper): Brass, 1/4 inch NPT male.

6. Diaphragm Seal: 316L Stainless steel wetted material rated at 15 psi (1 bar), threaded. Select top size to match gauge size.

2.3 THERMOMETERS

A. Manufacturers:

1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.

2. Moeller Instrument Company, Inc: www.moellerinstrument.com/#sle.

3. Watts Water Technologies, Inc: www.watts.com/#sle.

4. Weiss Instruments, LLC: www.weissinstruments.com/#sle.

5. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.

6. Winters Instruments: www.winters.com/#sle.

7. Substitutions: See Section 01 6000 - Product Requirements.

B. General:

1. Product Compliance: ASTM E1.

2. Lens: Clear glass, except where stated.

3. Accuracy: One percent, when tested in accordance with ASTM E77, except where stated.

4. Scale: Black markings depicting single scale in degrees F where expected process value falls half-span of standard temperature range.

C. Thermometers - Straight: 5 inch v-shape lead-free brass case with clear glass window scale, 2 inch NPT stem, 3-1/4 inch NPT thermowell, and red or blue non-toxic organic liquid filled glass tube.

D. Thermometers - Adjustable Angle: 7 inch v-shape aluminum case with clear glass window scale, 6 inch NPT stem, red or blue organic non-toxic liquid filled glass tube,

and adjustable joint with positive locking device allowing 360 degrees in horizontal plane or 180 degrees in vertical plane adjustments.

E. Thermometers - Dial Type:

1. Fixed: 5 inch diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch NPT stem.
   a. Remote-Local Reading: Include built-in platinum RTD probe for remote reading.

2. Adjustable Angle: 5 inch diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch NPT stem.

3. Vapor (Gas) Actuated: 4-1/2 inch glass-reinforced phenolic case, aluminum dial with black pointer, recalibrating screw, 2 inch brass thermowell, adjustable joint with positive locking device allowing 180 degrees in vertical plane adjustment and capillary.

2.4 PRESSURE-TEMPERATURE TEST PLUGS:

A. Manufacturers:

1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.

2. Watts Water Technologies, Inc: www.watts.com/#sle.

3. Weiss Instruments, LLC: www.weissinstruments.com/#sle.

4. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.

5. Winters Instruments: www.winters.com/#sle.

6. Substitutions: See Section 01 6000 - Product Requirements.

B. Size: 500 psi capacity; 1/2 inch MPT brass fitting with gasket, cap, and retaining strap for 1/8 inch pressure gauge or temperature probe.

C. Wetted Materials per Temperature Range:

1. Up to 200 degrees F: Brass probe with neoprene core.

2. 200 to 350 degrees F: Brass probe with EPDM core.

3. 350 to 400 degrees F: Brass probe with synthetic rubber core.

D. Accessories: Brass, lever-handle cock and snubber-filter.

E. Test Kit: Internally padded carrying case fitted with two 2-1/2 inch diameter pressure gauges, adapters, two 1/8 inch probes, and 1 inch dual-scale dial thermometers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify Utility Service Provider piping readiness to receive meter.

B. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports, and test plugs.

3.2 INSTALLATION

A. Install metering products in accordance with manufacturer's instructions for intended fluid type and service.

B. Provide water sub-meters on the cold water supply to the water heater. The meter at the water heater is to be installed upstream of the connection point of the recirculation system return.

C. Provide water sub-meters on the cold water feed to fixtures at the approximate location as indicated on the plumbing drawings.

D. Install water meters with inlet and outlet isolation valves in compliance with AWWA M6.

E. Install gas meters in accordance with Utility Service Provider instructions with required appurtenances.

F. Install rotameters (flowmeters) between 4 to 6 ft above finished floor unless instructed otherwise to allow easy readability.

G. Connect all meters and sub-meters to the building management system for remote readout.

H. Install pressure gauges as follows:

1. At Pumps: Place single gauge before strainer, suction side and discharge side.

2. Include gauge cock to isolate each gauge and extend nipples for insulation clearance.

3. Include siphons on high temperature systems and select type according to service rating.

4. Adjust gauges to selected viewing angle, clean thoroughly, and calibrate to zero.

I. Install thermometers as follows:

1. Hot Water Heaters: Place upstream and downstream of heater. Add one on the inlet end when using steam as the water heating medium.

2. Piping: Install thermometers in branch butt weld connection fitting or socket-weld thermowell. Enlarge pipes smaller than 2-1/2 inch to accommodate sockets. Ensure sockets are above insulation clearance.

J. Locate PT (pressure-temperature) test plugs adjacent to control device sockets.

3.3 SCHEDULES

A. Pressure Gauge Tappings, Location:

1. Control valves 3/4 inch & larger - inlets and outlets.

2. Major coils - inlets and outlets.

3. Heat exchangers - inlets and outlets.

B. Stem Type Thermometers, Location and Scale Range:

1. Domestic hot water supply and recirculation, 0 to 140 degrees F.

C. Thermometer Sockets, Location:

1. Control valves 1 inch & larger - inlets and outlets.

2. Reheat coils - inlets and outlets.

3. Cabinet heaters - inlets and outlets.

4. Unit heaters - inlets and outlets.

END OF SECTION 22 0519

SECTION 22 0523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ball valves.

B. Butterfly valves.

C. Check valves.

D. Gate valves.

1.2 RELATED REQUIREMENTS

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

B. Section 08 3100 - Access Doors and Panels.

C. Section 22 0553 - Identification for Plumbing Piping and Equipment.

D. Section 22 0719 - Plumbing Piping Insulation.

E. Section 22 1005 - Plumbing Piping.

1.3 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Non-rising stem.

E. OS&Y: Outside screw and yoke.

F. PTFE: Polytetrafluoroethylene.

G. RS: Rising stem.

H. TFE: Tetrafluoroethylene.

I. WOG: Water, oil, and gas.

1.4 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. API STD 594 - Check Valves: Flanged, Lug, Wafer, and Butt-Welding; 2022.

C. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).

D. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2026.

E. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard; 2025.

F. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022, with Errata (2023).

G. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

H. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2025.

I. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).

J. ASTM A536 - Standard Specification for Ductile Iron Castings; 2024.

K. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015 (Reapproved 2021).

L. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017 (Reapproved 2025).

M. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service; 2019.

N. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

O. MSS SP-67 - Butterfly Valves; 2022.

P. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.

Q. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.

R. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

S. NSF 61 - Drinking Water System Components - Health Effects; 2025, with Addendum

T. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.5 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

1. Include body material, seating material, trim materials, valve design, and arrangement.

2. Pressure and temperature classifications.

3. Certification that products comply with NSF 611 and NSF 372.

C. Shop Drawings: end connections details and required clearances.

1.6 CLOSEOUT SUBMITTALS

A. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

B. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

C. Valve Asset Schedule:

1. Furnish valve charts typed on 8.5 by 11-inch (216 by 279-mm) bond paper, showing locations of all manual and automatic control valves, and flow meters. Include:
   a. Number.
   b. Location.
   c. Service.
   d. Function.
   e. Area served.

2. The valve numbering system shall be approved by the Owner prior to final submittal. Place one copy of the approved chart in a plastic envelope and mount on wall where directed. Provide another copy for each of the Operating and Maintenance Manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer:

1. Obtain valves for each valve type from single manufacturer.

2. The manufacturer shall be fully certified by the International Standards Organization per ISO 9001.

B. Ferrous valves shall conform to ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. Copper alloy valves (brass and bronze) shall have no more than 15 percent zinc in the alloy.

D. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF 61 and NSF 372 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.

E. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements. Product specifications herein may not define all product options necessary to meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF 61 and NSF 372 for domestic water systems.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Use the following precautions during storage:

1. Maintain valve end protection and protect flanges and specialties from dirt.
   a. Provide temporary inlet and outlet caps.
   b. Maintain caps in place until installation.

2. Store valves in shipping containers and maintain in place until installation.
   a. Store valves indoors in dry environment.
   b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

PART 2 - PRODUCTS

2.1 APPLICATIONS

A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

B. Provide the following valves for the applications if not indicated on drawings:

1. Shutoff: Ball, butterfly, gate.

2. Throttling: Provide ball or butterfly.

C. Required Valve End Connections for Non-Wafer Types:

1. Copper Tube:
   a. 2 inch and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   b. 2-1/2 inch to 4 inch: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.

D. Low Pressure, Compressed Air Valves 150 psi or Less:

1. 2 inch and Smaller:
   a. Ball: Three piece, full port, brass with brass trim.

E. High Pressure, Compressed Air Valves 150 psi to 200 psi:

1. 2 inch and Smaller:
   a. Ball: One piece, full port, brass with brass trim.

F. Domestic, Hot and Cold Water Valves:

1. 2 inch and Smaller:
   a. Bronze and Brass: Provide with solder-joint ends.
   b. Bronze Angle: Class 125, bronze disc.
   c. Ball: Two piece, full port, brass with brass trim.
   d. Bronze Swing Check: Class 125, bronze disc.

2. 2-1/2 inch and Larger:
   a. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.
   b. Iron Grooved-End Butterfly: 175 CWP.
   c. Iron Swing Check: Class 125, metal seats.

G. Gas Valves:

1. 2 inch and Smaller:
   a. Shut-off Isolation: Bronze two-piece, full port ball valve.

2.2 GENERAL REQUIREMENTS

A. All valves shall be in accordance with AWWA C500 regulations

B. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

C. Valve Sizes: Match upstream piping unless otherwise indicated.

D. Insulated Piping Valves: With 2 inch stem extensions and the following features:

1. Gate Valves: Rising stem.

2. Ball Valves: 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: Extended neck.

4. Memory Stops: Fully adjustable after insulation is installed.

E. Valve-End Connections:

1. Threaded End Valves: ASME B1.20.1.

2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.

3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.

4. Solder Joint Connections: ASME B16.18.

F. Potable Water Use:

1. Certified: Approved for use in compliance with NSF 61 and NSF 372.

2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.

2.3 BRASS, BALL VALVES

A. Two Piece, Full Port with Brass Trim:

1. Comply with MSS SP-110.

2. WSP Rating: 150 psi.

3. WOG Rating: 600 psi.

4. Body: Forged brass.

5. Seats: PTFE or TFE.

6. Stem: Brass.

7. Ball: Chrome-plated brass.

8. Operator: Lockable handle, memory stop, and stem extension.

B. Three Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110.

2. WSP Rating: 150 psi.

3. CWP Rating: 600 psi.

4. Body: Forged brass.

5. End Connections: Pipe thread.

6. Seats: PTFE.

7. Stem: Brass.

8. Ball: Stainless steel, vented.

9. Operator: Provide lockable handle.

2.4 BRONZE, BALL VALVES

A. General:

1. Fabricate from dezincification resistant material.

2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Bronze Trim:

1. Comply with MSS SP-110.

2. WSP Rating: 150 psi.

3. WOG Rating: 600 psi.

4. Body: Forged bronze.

5. Ends Connections: Pipe thread or solder.

6. Seats: TFE.

7. Stem: Bronze, blowout proof.

8. Ball: Chrome plated brass.

9. Operator: Provide lockable handle and stem extension.

2.5 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Wafer and Lug Style:

1. Class 125, or Class 150 flanges.

2. Comply with MSS SP-67, Type I.

3. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.

4. Stem: One or two-piece stainless steel.

5. Seat: EPDM.

6. Disc: Aluminum-bronze.

7. Finish: Epoxy coated.

8. Operator: Lockable handle over direct-mount actuator base.

2.6 IRON, GROOVED-END BUTTERFLY VALVES

A. CWP Rating: 175 psi.

1. Comply with MSS SP-67, Type I.

2. Body: Coated ductile iron.

3. Stem: Two-piece stainless steel.

4. Disc: Coated ductile iron.

5. Disc Seal: EPDM.

2.7 BRONZE, LIFT CHECK VALVES

A. General:

1. Fabricate from dezincification resistant material.

2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125:

1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.

2. CWP Rating: 200 psi.

3. Design: Vertical flow.

4. Body: Comply with ASTM B61 or ASTM B62, bronze.

5. End Connections: Threaded.

6. Disc (Type 1): Bronze.

2.8 BRONZE, SWING CHECK VALVES

A. General:

1. Fabricate from dezincification resistant material.

2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125: CWP Rating: 200 psig (1380 kPa).

1. Design: Y-pattern, horizontal or vertical flow.

2. WOG Rating: 200 psi.

3. Body: Bronze, ASTM B62.

4. Ends: Threaded or soldered as indicated.

5. Disc: Bronze.

2.9 BRONZE, GATE VALVES

A. General:

1. Fabricate from dezincification resistant material.

2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Rising Stem or OS&Y:

1. Pressure-Temperature Range: MSS SP-80, Type I.

2. Class 150: CWP Rating; 300 psi.

3. Body: ASTM B62, bronze with integral seat and screw-in bonnet.

4. End Connections: Threaded or solder.

5. Stem: Bronze.

6. Disc: Solid wedge; bronze.

7. Packing: Asbestos free.

8. Handwheel Operator: Malleable iron.

2.10 IRON, GATE VALVES

A. OS & Y:

1. Pressure and Temperature Rating: MSS SP-70, Type I.

2. Body: ASTM A126, gray iron with bolted bonnet.

3. End Connections: Flanged.

4. Trim: Bronze.

5. Disc: Solid wedge.

6. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.2 INSTALLATION

A. General:

1. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

2. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

B. Manual water shut-off valve:

1. Provide a valve at house side of each water meter and sub-meter.

2. Provide valves in branch lines as indicated on drawings.

3. Provide valves at each connection to equipment, adjacent to the equipment.

4. Provide a shut-off valve upstream at each regulator.

5. Install valves readily accessible for operation and maintenance, with ample clearance for turning wheel handles or operators.

6. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve. Unions are not required at flanged connections.

C. Manual gas shut-off valve:

1. Provide a valve at house side of each gas meter.

2. Provide valves in branch lines as indicated on drawings.

3. Provide valves in each connection to equipment, adjacent to the equipment.

4. Provide a shut-off valve upstream at each automatic gas safety shut-off valve.

5. Provide a shut-off valve upstream at each regulator.

6. Install valves readily accessible for operation and maintenance, with ample clearance for turning wheel handles or operators.

7. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve. Unions are not required at flanged connections.

D. Install check valves where necessary to maintain direction of flow as follows:

1. Swing Check: Install horizontal maintaining hinge pin level.

3.3 LABELING AND IDENTIFICATION

A. Refer to section 22 0553 - Identification for Plumbing Piping and Equipment.

3.4 PAINTING

A. Refer to Division 9 for painting interior and exterior natural-gas piping.

B. Comply with requirements in Section 22 0500 - Common Work Results for Plumbing.

C. Prime and paint exterior above-grade piping, and valves, regulators, meters and piping specialties OSHA yellow. Do not paint flexible connectors.

END OF SECTION 22 0523

SECTION 22 0529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Prefabricated trapeze-framed systems.

B. Strut systems for pipe or equipment support.

C. Beam clamps.

D. Pipe hangers.

E. Pipe rollers and roller supports.

F. Pipe supports, guides, shields, and saddles.

G. Anchors and fasteners.

1.2 RELATED REQUIREMENTS

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

B. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

C. Section 05 5000 - Metal Fabrications.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2026).

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

F. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2025.

G. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.

H. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).

I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.

J. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2025.

K. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

L. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.

M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.

N. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

O. FM (AG) - FM Approval Guide; Current Edition.

P. MFMA-4 - Metal Framing Standards Publication; 2004.

Q. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.

R. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

S. UL (DIR) - Online Certifications Directory; Current Edition.

T. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.

2. Coordinate the work with other trades to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.

4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.5 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, non-penetrating rooftop supports, and thermal insulated pipe supports.

1. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered proprietary. Any item comparable in type, style, quality, design, and performance will be considered for approval.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution. Show fabrication and installation details and include calculations for the following

components. Provide signed and sealed by a qualified professional engineer here materials or methods other than those indicated are proposed for substitution.

1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.

2. Trapeze pipe hangers.

3. Metal framing systems.

4. Pipe stands.

5. Equipment supports.

D. 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.

1. Detail fabrication and assembly of trapeze hangers.

2. Floor plans showing locations where trapeze hangers and hangers or supports affiliated with more than one pipe attached to the building.

3. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 CLOSEOUT SUBMITTALS.

A. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.7 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.

B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.

C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 1.5. Include consideration for vibration, equipment operation, and shock loads where applicable.

D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

E. Fire Resistance: Provide hardware rated for 60 minutes resistance unless specifically indicated by the authority having jurisdiction.

F. Materials for Metal Fabricated Supports: Comply with Section 05 5000.

1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.

2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.

G. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.

1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.

2. Outdoor, Damp, or Wet-Indoor Locations: Use stainless steel unless otherwise indicated.

2.2 PREFABRICATED TRAPEZE-FRAMED SYSTEMS

A. Prefabricated Trapeze-Framed Metal Strut Systems:

1. Manufacturers:
   a. Anvil International, LLC: www.asc-es.com/#sle.
   b. Custom Strut and Roll Forming, LLC: www.customstrut.com/#sle.
   c. Gripple, Inc; Fast Track - Standard: www.gripple.com/#sle.
   d. Unistrut, a brand of Atkore International, Inc; S1S: www.unistrut.com/#sle.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. MFMA-4 compliant, pre-fabricated, MSS SP-58 Type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.

3. Strut Channel or Bracket Material:
   a. Indoor Dry Locations: Use zinc-plated steel or galvanized steel.
   b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.

4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.

5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.

6. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

2.3 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

A. Strut Channels:

1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation; B22 or heavier: www.eaton.com/#sle.
   b. Substitutions: See Section 01 6000 - Product Requirements.
   c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.

3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.

B. Welded Steel Brackets:

1. Manufacturers:

C. Welded Steel Brackets:
   a. B-Line, a brand of Eaton Corporation; B3063, B3066, and B3067: www.eaton.com/#sle.

2. Manufacturers:
   a. B-Line, a brand of Eaton Corporation; B3063, B3066, and B3067: www.eaton.com/#sle.
   b. Substitutions: See Section 01 6000 - Product Requirements.
   c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
   d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

3. Wall or column supported pipes shall be supported by welded steel brackets as required for pipe sizes up to and including 20" diameter.

4. Wall or column supported pipes shall be supported by welded steel brackets as required for pipe sizes up to and including 20" diameter.

D. Hanger Rods:

1. Manufacturers:
   a. ATR.

2. Manufacturers:
   a. B-Line, a brand of Eaton Corporation; B3205: www.eaton.com/#sle.
   b. ATR.
   c. Substitutions: See Section 01 6000 - Product Requirements.
   d. B-Line, a brand of Eaton Corporation; B3205: www.eaton.com/#sle.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
   f. Substitutions: See Section 01 6000 - Product Requirements.
   g. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

3. Threaded zinc-plated steel unless otherwise indicated.

4. Minimum Size, Unless Otherwise Indicated or Required:
   a. Hanger rod diameters shall be based on MSS SP-69 Table 4.
   b. Hanger rod diameters shall be based on MSS SP-69 Table 4.
   c. Equipment Supports: 1/2 inch diameter.
   d. Piping up to 1 inch: 1/4 inch diameter.
   e. Piping larger than 1 inch: 3/8 inch diameter.

E. Channel Nuts:

1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
   b. FNW; 7821: www.fnw.com/#sle.
   c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
   d. Substitutions: See Section 01 6000 - Product Requirements.
   e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

2.4 BEAM CLAMPS

A. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

B. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.5 PIPE HANGERS

A. Swivel Ring Hangers, Adjustable:

1. MSS SP-58 type 10, epoxy-painted, zinc-colored.

2. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

3. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.

B. Clevis Hangers, Adjustable:

1. Manufacturers:
   a. Anvil International, LLC: www.asc-es.com/#sle.
   b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
   c. FNW; 7005: www.fnw.com/#sle.
   d. Michigan.
   e. PHD.
   f. Substitutions: See Section 01 6000 - Product Requirements.
   g. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.

3. UL (DIR) listed: Pipe sizes 2-1/2 to 8 inch.

2.6 PIPE CLAMPS

A. Riser Clamps:

1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation; B3373, B3131, B3373CT: www.eaton.com/#sle.
   b. Substitutions: See Section 01 6000 - Product Requirements.
   c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.

3. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.

4. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.

B. Extension Split Pipe Clamp:

1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation; B3140 or B3142: www.eaton.com/#sle.
   b. Substitutions: See Section 01 6000 - Product Requirements.
   c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. MSS SP-58 type 12, hinged split ring and yoke roller hanger with epoxy copper or plain finish.

3. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.

4. Provide hanger rod and nuts of the same type and material for a given pipe run.

5. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

C. Insulation Coupling:

1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation; B3144 or B3146: www.eaton.com/#sle.
   b. B-Line, a brand of Eaton Corporation; B3144 or B3146: www.eaton.com/#sle.
   c. Substitutions: See Section 01 6000 - Product Requirements.
   d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. Two bolt-type clamps designed for installation under insulation.

3. Material: Carbon steel with epoxy copper or zinc finish.

2.7 PIPE ROLLERS AND ROLLER SUPPORTS

A. Manufacturers:

1. B-Line, a brand of Eaton Corporation; B218, B219, B379, B479, or B3126: www.eaton.com/#sle.

2. B-Line, a brand of Eaton Corporation; B218, B219, B379, B479, or B3126: www.eaton.com/#sle.

3. Substitutions: See Section 01 6000 - Product Requirements.

4. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

B. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.

C. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

2.8 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

B. Stanchions:

1. Manufacturers:
   a. B-Line, a brand of Eaton Corporation; B3093 with B3088T or B3090 with B3088: www.eaton.com/#sle.
   b. Substitutions: See Section 01 6000 - Product Requirements.
   c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.

3. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.

4. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.

5. Floor supported pipes 3" and larger in diameter shall be supported by either cast-in-place concrete supports or adjustable pipe saddle supports as directed by the Engineer. In general, concrete supports shall be used when lateral displacement of the pipes is probable (unless lateral support is provided), and adjustable pipe saddle type supports shall be used where lateral displacement of the pipes is not probable.

6. Each adjustable pipe saddle support shall be screwed of welded to the corresponding size base stand. Supporting pipe shall be of schedule 40 steel pipe construction. Each base stand shall be secured to the concrete floor by expansion bolts.

7. Floor supported pipes 3" and larger in diameter shall be supported by either cast-in-place concrete supports or adjustable pipe saddle supports as directed by the Engineer. In general, concrete supports shall be used when lateral displacement of the pipes is probable (unless lateral support is provided), and

adjustable pipe saddle type supports shall be used where lateral displacement of the pipes is not probable.

8. Each adjustable pipe saddle support shall be screwed of welded to the corresponding size base stand. Supporting pipe shall be of schedule 40 steel pipe construction. Each base stand shall be secured to the concrete floor by expansion bolts.

C. Intermediate Anchors and Pipe Alignment Guides:

1. Pipe Sizes 6 inch and Smaller: Minimum clearance of 0.16 inch.

2. Pipe Size 8 inch: 0.625 inch U-bolt with double nuts providing minimum clearance of 0.28 inch.

3. Pipe Size 10 inch: 0.75 inch U-bolt.

4. Pipe Sizes 12 to 16 inch: 0.875 inch U-bolt.

5. Pipe Sizes 18 to 30 inches: 1 inch U-bolt.

6. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.

D. Pipe Alignment Guides:

1. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.

2. Pipe Sizes 10 inch and Larger: Roller type.

E. Pipe Shields for Insulated Piping:

1. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.

2. General Construction and Requirements:
   a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
   b. Shields Material: UV-resistant polypropylene with glass fill.
   c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
   d. Service Temperature: Minus 40 to 178 degrees F.
   e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

F. Pipe Supports:

1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2. Liquid Temperatures Up to 122 degrees F:
   a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
   b. Support From Below: MSS SP-58 types 35 through 38.

3. Operating Temperatures from 122 to 446 degrees F:
   a. Overhead Support: MSS SP-58 type 1 or 3 through 12 clamps with appropriate saddle of MSS SP-58 type 40 for insulated pipe.
   b. Roller Chair: MSS SP-58 types 41 or 43 through 46 roller chair support with appropriate saddle of MSS SP-58 type 39 for insulated pipe.
   c. Sliding Support: MSS SP-58 types 35 through 38.

G. Pipe Supports, Thermal Insulated:

1. Manufacturers:
   a. Aeroflex USA, Inc; Aerofix-U Pipe Supports: www.aeroflexusa.com/#sle.
   b. Buckaroos, Inc: www.buckaroos.com/#sle.
   c. Substitutions: See Section 01 6000 - Product Requirements.

2. General Requirements:
   a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
   b. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
   c. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
   d. Provide pipe supports for 1/2 to 30 inch iron pipes.
   e. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.

3. PVC Jacket:
   a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
   b. Minimum Service Temperature: Minus 40 degrees F.
   c. Maximum Service Temperature: 180 degrees F.

d. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
e. Minimum Thickness: 60 mil, 0.06 inch.

H. Copper Pipe Supports:

1. Manufacturers:
a. Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by single manufacturer.

I. Overhead Pipe Supports:

1. Manufacturers:
a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2.9 NONPENETRATING ROOFTOP SUPPORTS FOR LOW-SLOPE ROOFS

A. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.

B. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.

C. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

D. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

2.10 ANCHORS AND FASTENERS

A. Manufacturers - Mechanical Anchors:

1. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.

2. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.

3. Substitutions: See Section 01 6000 - Product Requirements.

B. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

C. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.

D. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.

E. Hollow Masonry: Use toggle bolts.

F. Hollow Stud Walls: Use toggle bolts.

G. Steel: Use beam ceiling clamps, beam clamps, machine bolts, or welded threaded studs.

H. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.

I. Sheet Metal: Use sheet metal screws.

J. Plastic and lead anchors are not permitted.

K. Powder-actuated fasteners are not permitted.

L. Hammer-driven anchors and fasteners are not permitted.

M. Preset Concrete Inserts: Continuous metal strut channel and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.

1. Channel Material: Use galvanized steel.

2. Manufacturer: Same as manufacturer of metal strut channel framing system.

N. Concrete Inserts:

1. Manufacturers:
   a. Continuous Inserts: B-Line, a brand of Eaton Corporation; B221, B321, or B521: www.eaton.com/#sle.
   b. Spot Inserts: B-Line, a brand of Eaton Corporation; B221, B321, or B521: www.eaton.com/#sle.
   c. Spot Inserts: B-Line, a brand of Eaton Corporation; B2505 thru B2508, B2500, or B3014: www.eaton.com/#sle.
   d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. Concrete inserts for pipe hangers shall be continuous metal inserts designed to be used in ceilings, walls, or floors, spot inserts for individual pipe hangers.

3. Continuous concrete inserts shall be used where applicable and shall be used for hanger rod sizes up to and including 3/4" diameter. Inserts to be used where supports are parallel to the main slab reinforcement.

4. Concrete inserts for pipe hangers shall be continuous metal inserts designed to be used in ceilings, walls, or floors, spot inserts for individual pipe hangers.

5. Continuous concrete inserts shall be used where applicable and shall be used for hanger rod sizes up to and including 3/4" diameter. Inserts to be used where supports are parallel to the main slab reinforcement.

6. Spot concrete inserts shall be used where applicable and shall be used for hanger sizes up to and including 7/8" diameter.

7. Spot concrete inserts shall be used where applicable and shall be used for hanger sizes up to and including 7/8" diameter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Confirm all hangers, rods, inserts, supports, supplementary steel, and all materials for hanging systems where installed outside of the building conditioned envelope shall be type 304 stainless steel.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Hangers and supports shall be spaced in accordance with MSS SP-69 Table 3.

D. Hanger rods shall be subjected to tension only. Lateral and axial movement shall be accommodated by proper linkage in the rod assemble.

E. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

F. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

G. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

H. Unless specifically indicated or approved by Architect and Structural Engineer, do not provide support from any metal decking. Supports shall be connected to primary structural framing systems including beams, and/or joists.

I. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

J. Strut channel trapeze hangers shall be used to support parallel piping. Pipe racks or stanchions fabricated with strut channel shall be used in areas of multiple pipe runs. Strut clamps, straps, and rollers will be used to maintain proper alignment.

K. Cut and trim all-thread rods to a maximum of 3 inches in length for proper head clearance.

L. Provide rubber stub end cap bottoms and cover all threaded rod locations where exposed, low height areas, and within 2 feet above ceilings of the ceiling grid.

M. All pipe roughing work to final users in metal or wood studded sheet rock walls shall utilize "Holdrite" brackets and inserts or an engineer-approved equal system. Plumbing Contractor shall be responsible for the proper bracket selection depending on pipe materials being supported Contact Engineer if material selection assistance is required or for approval of alternate support stem.

N. Where flexibility in the hanger assembly is required due to horizontal pipe movement, use pipe clamps.

O. Insulation to run continuously through pipe saddle type hangers.

P. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

Q. Riser piping shall be supported independently of any connected horizontal piping if possible.

R. Support all vertical runs of ambient piping at each floor or as specified by the manufacturer as required.

S. Equipment Support and Attachment:

1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.

2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

T. All piping buried below grade shall be supported throughout its entire length on a firm bed of earth or with concrete pad as required in order to ensure that pipes will not settle in the future.

U. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.

V. Secure fasteners according to manufacturer's recommended torque settings.

W. Remove temporary supports.

3.4 FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 22 0529

SECTION 22 0553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Labels.

C. Tags.

D. Pipe markers.

E. Underground warning tape.

F. Ceiling nameplate.

1.2 RELATED REQUIREMENTS

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

B. Section 09 9123 - Interior Painting: Identification painting.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

C. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2025.

1.4 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. See Section 01 3000 - Administrative Requirements for submittal procedures.

C. Schedules:

1. Submit plumbing component identification schedule listing equipment, piping, and valves.

2. Detail proposed component identification data in terms of of wording, symbols, letter size, and color coding to be applied to corresponding product.

3. Valve Data Format: Include id-number, location, function, and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

B. Provide valve schedule in each copy of the O & M manual.

C. Project Record Documents: Record actual locations of tagged valves.

PART 2 - PRODUCTS

2.1 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

A. Nameplates:

1. Heat exchangers, water heaters, and other heat transfer products.

2. Control panels, transducers, and other related control equipment products.

3. Pumps, tanks, filters, water treatment devices, and other plumbing equipment products.

B. Tags:

1. Piping: 3/4 inch diameter and smaller.

2. Manual operated and automated control valves.

3. Instrumentation, relays, gauges, and other related control equipment products.

4. Ceiling tacks placed on lay-in ceiling surface to reference plumbing components.

C. Pipe Markers: 3/4 inch diameter and higher.

2.2 NAMEPLATES

A. Manufacturers:

1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com/#sle.

2. Brady Corporation; B-1: www.bradycorp.com/#sle.

3. Brimar Industries, Inc; Briply: www.pipemarker.com/#sle.

4. Craftmark Pipe Markers: www.craftmarkid.com/#sle.

5. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.

6. Seton Identification Products; Setonflex: www.seton.com/#sle.

7. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: Laminated two-layer plastic with engraved letters.

1. Letter Color: White.

2. Letter Height: 1/4 inch.

3. Background Color: Black.

4. Nameplate Height: 3/4 inch.

5. Nameplate Material:
   a. Flexible: Vinyl with center-side holes for screw fastening per ASTM D709.

2.3 LABELS

A. Manufacturers:

1. Printer.

2. Handheld device.

B. Description: Laminated layered paper with printed letters.

1. Letter Color: Black.

2. Minimum Letter Height: 1/4 inch for all control panels and small items of equipment.

3. Background Color: White.

C. Label Content:

1. Principal lettering: Include equipment's unique equipment number/mark.

2. Secondary lettering: Mechanical equipment served, Electrical panel and circuit serving unit.

2.4 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving: www.advancedgraphicengraving.com/#sle.

2. Brady Corporation; B-907: www.bradycorp.com/#sle.

3. Brimar Industries, Inc: www.pipemarker.com/#sle.

4. Craftmark Pipe Markers: www.craftmarkid.com/#sle.

5. Marketing Services Incorporated.

6. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.

7. Seton Identification Products: www.seton.com/#sle.

8. Substitutions: See Section 01 6000 - Product Requirements.

B. Metal: Brass, 19 gauge 1-1/2 inch in diameter with smooth edges, blank, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.

C. Engraving: ¼” letters identifying the valve service (PLBG, HW, CW, etc.) above ½” valve numbers.

D. Valve Tag Chart: Typewritten 12-point letter size list in anodized aluminum frame.

2.5 PIPE MARKERS

A. Manufacturers:

1. Brimar Industries, Inc; EZ Pipe Markers w/ Arrow banding tape : www.pipemarker.com/#sle.

2. Marking Services Incorporated; ____.

3. Seton Identification Products; Setmark: www.seton.com/#sle.

4. Substitutions: See Section 01 6000 - Product Requirements.

B. Comply with ASME A13.1.

C. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.

D. Underground Flexible Marker: Bright-colored continuously printed ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

E. Identification Scheme, ASME A13.1:

1. Primary: External Pipe Diameter, Uninsulated or Insulated.
   a. 3/4 to 1-1/4 inches: Use 8 inch field-length with 1/2 inch text height.
   b. 1-1/2 to 2 inches: Use 8 inch field-length with 3/4 inch text height.
   c. 2-1/2 to 6 inches: Use 12 inch field-length with 1-1/4 inch text height.
   d. 8 to 10 inches: Use 24 inch field-length with 2-1/2 inch text height.
   e. Over 10 inches: Use 32 inch field-length with 3-1/2 inch text height.

2. Secondary: Color scheme per fluid service.
   a. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.

2.6 CEILING NAMEPLATE

A. Manufacturers:

1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com/#sle.

2. Brady Corporation; B-1: www.bradycorp.com/#sle.

3. Brimar Industries, Inc; Briply: www.pipemarker.com/#sle.

4. Craftmark Pipe Markers: www.craftmarkid.com/#sle.

5. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.

6. Seton Identification Products; Setonflex: www.seton.com/#sle.

7. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: Laminated two-layer plastic with engraved letters.

1. Letter Color: Black.

2. Letter Height: 1/4 inch.

3. Background Color: White.

4. Nameplate Height: 3/4 inch.

5. Nameplate Material:
   a. Flexible: Vinyl with center-side holes for screw fastening per ASTM D709.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive identification products.

3.2 INSTALLATION

A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags in clear view and align with axis of piping

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Apply ASME A13.1 Pipe Marking Rules:

1. Place pipe marker adjacent to changes in direction.

2. Place pipe marker adjacent each valve port and flange end.

3. Place pipe marker at both sides of floor and wall penetrations.

4. Place pipe marker every 25 to 50 feet interval of straight run.

G. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

3.3 SCHEDULE

A. Provide a valve schedule, located in a mechanical room or at a location of the Owner's request.

B. Refer to the drawings.

END OF SECTION 22 0553

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SECTION 22 0719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cellular glass insulation.

B. Glass fiber insulation.

C. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

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

B. Section 07 8400 - Firestopping.

C. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).

C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).

D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2026.

F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2025.

G. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.

H. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.

I. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).

J. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.

L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

M. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.

N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.8 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 - PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER INSULATION

A. Manufacturers:

1. Johns Manville Corporation; Micro-Lok HP: www.jm.com/#sle.

2. Knauf Insulation: www.knaufinsulation.com/#sle.

3. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulation: ASTM C547 and ASTM C795; rigid, preformed pipe insulation, noncombustible.

1. K Value: ASTM C177, 0.24 at 75 degrees F.

2. Maximum Service Temperature: 850 degrees F.

3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

1. Interior wet-applied mastics, paints, and coatings: Comply with emissions requirements of CAL (CDPH SM) Standard Test Method and VOC content limits in Section 018113.

2.3 CELLULAR GLASS INSULATION

A. Insulation: ASTM C552, Type II, Grade 6.

1. K Value: 0.35 at 100 degrees F.

2. Service Temperature Range: From 250 degrees F to 800 degrees F.

3. Water Vapor Permeability: 0.005 perm inch maximum per inch.

4. Water Absorption: 0.5 percent by volume, maximum.

2.4 POLYETHYLENE INSULATION

A. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.

1. K Value: ASTM C177; 0.25 at 75 degrees F.

2. Maximum Service Temperature: 200 degrees F.

3. Density: 2 pcf.

4. Maximum Moisture Absorption: 1.0 percent by volume.

5. Moisture Vapor Permeability: 0.05 perm inch, when tested in accordance with ASTM E96/E96M.

6. Connection: Contact adhesive.

2.5 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.

1. Minimum Service Temperature: Minus 40 degrees F.

2. Maximum Service Temperature: 220 degrees F.

3. Connection: Waterproof vapor barrier adhesive.

2.6 JACKETING AND ACCESSORIES

A. PVC Plastic Jacket:

1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
   a. Minimum Service Temperature: 0 degrees F.
   b. Maximum Service Temperature: 450 degrees F.
   c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
   d. Connections: Brush on welding adhesive.

B. Aluminum Jacket:

1. Thickness: 0.016 inch sheet.

2. Finish: Smooth.

3. Joining: Longitudinal slip joints and 2 inch laps.

4. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. Glass fiber insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.

2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

H. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

3. Insert Location: Between support shield and piping and under the finish jacket.

4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 8400.

J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

K. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil, 0.001 inch thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

3.3 FINISHES

A. Paint all un-insulated piping and supporting structures that are exposed to outdoor weather conditions.

3.4 SCHEDULES

A. Refer to the drawings.

END OF SECTION 22 0719

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SECTION 22 1005 - PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sanitary waste piping, buried within 5 feet of building.

B. Sanitary waste piping, above grade.

C. Grease waste piping, buried beyond 5 feet of building.

D. Grease waste piping, buried within 5 feet of building.

E. Grease waste piping, above grade.

F. Domestic water piping, buried within 5 feet of building.

G. Domestic water piping, above grade.

H. Natural gas piping, buried within 5 feet of building.

I. Natural gas piping, above grade.

J. Pipe flanges, unions, and couplings.

K. Pressure Testing

1.2 RELATED REQUIREMENTS

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

B. Section 08 3100 - Access Doors and Panels.

C. Section 09 9123 - Interior Painting.

D. Section 22 0516 - Expansion Fittings and Loops for Plumbing Piping.

E. Section 22 0529 - Hangers and Supports for Plumbing Piping and Equipment.

F. Section 22 0553 - Identification for Plumbing Piping and Equipment.

G. Section 22 0719 - Plumbing Piping Insulation.

H. Section 31 2316 - Excavation.

I. Section 31 2323 - Fill.

J. Section 33 0110.58 - Disinfection of Water Utility Piping Systems.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ANSI LC 1/CSA 6.26 - Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing; 2023.

C. ANSI Z223.1 - National Fuel Gas Code; 2024.

D. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).

E. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.

F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

H. ASME B31.1 - Power Piping; 2024.

I. ASME B31.9 - Building Services Piping; 2025.

J. ASME BPVC - Boiler and Pressure Vessel Code; 2025.

K. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025, with Errata.

L. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2026).

M. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

N. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2026.

O. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2025.

P. ASTM B32 - Standard Specification for Solder Metal; 2020.

Q. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2026.

R. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

S. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

T. ASTM B813 - Standard Specification for Water Flushable Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2024.

U. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.

V. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2026.

W. ASTM C1277 - Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.

X. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings; 2007 (Reapproved 2023).

Y. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.

Z. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2026.

AA. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025, with Amendment (2026).

BB. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.

CC. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.

DD. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2023.

EE. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances; 2023.

FF. AWWA C606 - Grooved and Shouldered Joints; 2022.

GG. AWWA C651 - Disinfecting Water Mains; 2023.

HH. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.

II. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.

JJ. NFPA 54 - National Fuel Gas Code; 2024.

KK. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

LL. NSF 61 - Drinking Water System Components - Health Effects; 2025, with Addendum

MM. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.4 UTILITY COORDINATION

A. New water and gas service will be installed by the utility provider. Make arrangements for, and have this service installed, at the appropriate scheduled time. Submit the bill upon completion of this part of the work. Owner will pay the utility company.

1.5 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Shop Drawings: In accordance with Division 1. Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved. For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.

1. Suspended ceiling components.

2. Other building services.

3. Structural members.

D. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.

2. Locations of pipe anchors and alignment guides and expansion joints and loops.

3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.

4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Provide minimum 18" x 24" drawing of building floor plans. Record actual locations of valves clearly labeled. Provide two physical and digital copies to Owner.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements for additional provisions.

1.7 REGULATORY REQUIREMENTS

A. All pipe shall conform to Chapter 6 of the of the NC Plumbing Code.

B. All pipe, fittings, valves, faucets, etc., or any product used for dispensing potable water shall be fully compliant with the “Reduction of Lead in Drinking Water Act” and shall meet the requirements of NSF 61 and NSF 372 test standards.

C. Installation of gas piping shall meet requirements of the authority having jurisdiction, the gas supplier for gas service, and NFPA 54.

D. Upon completion of the work, the piping shall be tested as required by inspection authorities having jurisdiction.

1.8 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.

1. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. Pipe Welding Qualifications: Qualify procedures and operators according to ASME BPVC, Boiler and Pressure Vessel Code.

E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

F. UL label and local testing.

G. Tester Qualification: Company specializing in performing the type of work specified in this section. All pressure tests shall be conducted by qualified personnel. When requested the qualifications of individuals shall be submitted to the Architect for approval.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

E. Protect stored PE pipes and valves from direct sunlight.

1.10 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

1.11 NOTIFICATIONS

A. The Architect/Engineer, Code Authorities having jurisdiction, and Owner's Representative shall be notified 7 days prior to all tests.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, solder, and flux (if used), complying with NSF 61 and NSF 372; label pipe and fittings.

2.2 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 extra heavy weight.

1. Fittings: Cast iron.

2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

2.3 SANITARY WASTE PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron.

2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.4 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B88 (ASTM B88M), Type K, drawn temper.

1. Joints: ASTM B32, solder.

B. Ductile Iron Pipe: AWWA C151/A21.51.

1. Fittings: Ductile or gray iron, standard thickness.

2. Joints: AWWA C111/A21.11, styrene butadiene rubber (SBR) or vulcanized SBR gasket with 3/4 inch diameter rods.

2.5 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Pipe: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).

1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.

2. Joints: ASTM B32 solder.

2.6 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M, Grade B, Type F, Schedule 40 black.

1. Fittings: ASTM A234/A234M, wrought steel welding type.

2. Joints: ASME B31.1, welded.

3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2.7 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.

2. Joints: Threaded or welded to ASME B31.1.

B. Equipment

1. Manufacturers:
   a. Flex-Hose Inc; UltraFuelFlex Braided Metal Connector.
   b. Mason Industries.
   c. Metraflex.
   d. Omega Flex, Inc; TracPipe CounterStrike: www.omegaflex.com/#sle.
   e. Substitutions: See Section 01 6000 - Product Requirements.

2. Working pressure: 50 psig.

3. Connections: Threaded ends, comply with ASME B1.20.1.

4. Maximum length: 36 inches.

C. Appliance Flexible Gas Piping:

1. Corrugated 304 Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.

2. Comply with ASTM E84.

3. Operating pressure rating: 0.5 psig.

4. Fittings: Provided by piping system manufacturer.

5. End Fittings: Flared nuts and threaded adapters, brass or zinc coated steel.

6. Connections: Threaded ends, comply with ASME B1.20.1.

7. Maximum length: 36 inches.

8. Application:
   a. Appliance flexible connectors.
   b. Indoor/outdoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24 and ASNSI Z21.75.
   c. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.

9. Manufacturers:
   a. Brass Craft.
   b. Dormont flexible connectors.
   c. Omega Flex, Inc; TracPipe CounterStrike: www.omegaflex.com/#sle.
   d. ProCoat.
   e. Substitutions: See Section 01 6000 - Product Requirements.

2.8 PIPE FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 inch and Under:

1. Ferrous Pipe: Class 150 malleable iron threaded unions.

2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Sizes Over 1 inch:

1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.

1. Dimensions and Testing: In accordance with AWWA C606.

2. Housing Material: Provide ASTM A47/A47M malleable iron or ductile iron, galvanized.

3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.

4. When pipe is field grooved, provide coupling manufacturer's grooving tools.

D. No-Hub Couplings:

1. Testing: In accordance with ASTM C1277 and CISPI 310.

2. Gasket Material: Neoprene complying with ASTM C564.

3. Band Material: Stainless steel.

4. Eyelet Material: Stainless steel.

E. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

1. Manufacturers:
   a. Epco.
   b. Mayco.
   c. Substitutions: See Section 01 6000 - Product Requirements.

F. Joining Materials:

1. Joint Compound and Tape: Suitable for natural gas or water.

2. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

3. Brazing Filler Metals: Alloy with melting point greater than 1000 degrees F (540 degrees C) complying with AWS A5.8M/A5.8. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.9 TESTING EQUIPMENT

A. Provide all material, test equipment, instruments, and labor required for the tests. All instruments shall be properly calibrated and shall have records on calibration.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

B. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Install piping as indicated on the drawings, in accordance with the regulations of the local authority and local gas utility company, and in accordance with installation and testing requirements.

B. Install in accordance with manufacturer's instructions.

C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

D. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

E. Install piping free of sags and bends.

F. Install piping to maintain headroom, conserve space, and not interfere with use of space.

G. Group piping whenever practical at common elevations.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 22 0516.

I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

J. Provide access where valves and fittings are not exposed.

1. Coordinate size and location of access doors with Section 08 3100.

K. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

L. Take branches from horizontal runs from side or top of such runs. A tee shall be placed at the bottoms of risers in gas piping. Bottom of tee shall be provided with a six-inch-long nipple and cap the same size as riser. When riser is concealed, the cap shall project through wall to be accessible and shall be properly marked with

engraved plastic nameplate, "DANGER, GAS, CLEANOUT". Red background with white letters.

M. Vents:

1. Plumbing vents to the exterior are to be routed through the roof as indicated on drawings and are to be coordinated with the Architect and all other exterior penetrations.

2. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

3. Where pipes pass through roof, flash with a 30" square of four-pound sheet lead or 16-ounce copper. Turn flashing up a minimum of 6" and install flashing sleeve or turn down lead flashing a minimum of 2" into pipe. Rubber flashing collars are not acceptable except if required by the roofing system installed

4. Where no rooftop vent penetration is provided and required to exit the building through the wall, provide an appropriate sidewall vent cap approved by the Architect. Ensure the pipe is not visible on the exterior of the building.

5. All vent sleeves shall be extended to the exterior of the building and vented via a gooseneck fitting as detailed on drawings.

N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.

O. Provide support for utility meters in accordance with requirements of utility companies.

P. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.

1. Paint all un-insulated piping and supporting structures that are exposed to outdoor weather conditions.

Q. Below Grade Exterior Piping:

1. Pipe trench is to be a minimum of 24 inches deep below finished grade.

2. Excavate in accordance with Section 31 2316.

3. Backfill in accordance with Section 31 2323.

4. All underground service piping shall rise above ground immediately before entering the building.

5. Gas pipes shall never be installed underground within the building.

6. Polyelthene (PE) pipe and fittings:
   a. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping them with a clean cloth or paper towels. Join according to ASTM D2657.
   b. Plain-End Pipe and Fittings: Use butt fusion.
   c. Plain-End Pipe and Socket Fittings: Use socket fusion.

7. Provide detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

R. Below Grade Interior Piping:

1. Install conduit.

2. Where pipe rises through floor, cut conduit flush with the floor.

3. Provide stainless steel insect screen where piping emerges from the conduit, with a hole cut in it large enough to accommodate the pipe in order to allow the conduit to vent.

S. Install valves with stems upright or horizontal, not inverted. See Section 22 0523.

T. Install water piping to ASME B31.9.

U. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

V. Sleeve pipes passing through partitions, walls, and floors.

W. Minimize quantity of soldered joints below concrete slab.

X. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

Y. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9.

2. Support horizontal piping as indicated.

3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.

6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

7. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

8. Support cast iron drainage piping at every joint.

Z. Gas Equipment Connections

1. General:
   a. Install natural-gas piping electrically continuous, and bonded to the equipment grounding conductor of the circuit powering the equipment according to NFPA 70. Do not use natural-gas piping as a grounding electrode.
   b. Install piping adjacent to equipment to allow service and maintenance.
   c. Connect piping to equipment using manual gas shutoff valves and unions. Install an isolation valve near each piece of equipment. Install union between valve and equipment. Unions are not required at flanged connections.

2. Owner-supplied appliances and appliance specified and furnished in other Divisions:

a. Connect to owner-supplied appliances, and other appliances requiring gas connections, that are specified and furnished in other specification Divisions or listed on the drawings.
b. Refer to Division 26 for grounding and bonding requirements.
c. Provide a pressure regulator where the service pressure is in excess of the appliance inlet pressure range.
    1) Provide an appliance regulator where the inlet pressure is below 0.5 psig or 14 inches w.g. (3.45 kPa) and the outlet pressure is less than 12 inches w.g. (3.0 kPa).
    2) Provide a line pressure regulator where the inlet pressure is above 0.5 psig or 14 inches w.g. (3.45 kPa) or the outlet pressure is more than 12 inches w.g. (3.0 kPa).
d. Provide appliance flexible connectors for where the inlet gas pressure is 0.5 psig or 14 inches w.g. (3.45 kPa) or below:
    1) Provide fixed-appliance flexible connectors for appliances without castors.
    2) Provide movable-appliance flexible connectors and restraints for appliances with castors.
e. Provide rigid piping connection where the inlet gas pressure is above 0.5 psig or 14 inches w.g. (3.45 kPa).

3. Boilers, condensing equipment, and exterior equipment:
    a. Provide a line pressure regulator with internal relief where the service pressure is in excess of the appliance inlet pressure range.
    b. Provide a minimum of 10 feet (3 meters) of gas piping between the regulator and the downstream equipment connection. Provide elbows and additional piping as needed to accommodate the required length. Provide the piping a minimum of two pipe sizes larger than the regulator outlet or equipment connection, whichever is larger, in order to create a reservoir of gas a minimize pressure fluctuations. Provide reducers and increasers as required.
    c. Provide rigid piping connection.

3.4 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C.

D.

E. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

F. Install ball or butterfly valves for throttling, bypass, or manual flow control services.

3.5 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.

B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.6 FIELD TESTS AND INSPECTIONS

A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.

B. The Contractor shall conduct and bear the cost of all necessary tests of the plumbing work, furnishing all labor, power and equipment. The contractor shall notify the engineer at least forty-eight (48) hours prior to all testing. Any test conducted without the Architect/Engineer or Owner's Representative present shall be considered as having not been performed, and such systems shall be retested in the presence of the Architect/Engineer or Owner's Representative at the expense of the contractor.

C. Any delays or additional cost to the project that result from the failure of the contractor to properly test all systems shall be the sole responsibility of the contractor.

D. Domestic Water Systems:

1. Perform hydrostatic testing for leakage prior to system disinfection.

2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
   a. Blank off equipment not designed for test pressure.

3. General:
   a. Potable water hydrostatic pressure test shall be conducted in accordance with AWWA C600-82, Section 4.1. The duration of this test shall be for a minimum of two (2) hours, and the test pressure shall be 1.5 times the design pressure or 150 psi, whichever is greater.

b. Fill the system with water and raise static head to 10 psi above service pressure. Minimum static head of 50 to 150 psi. As an exception, certain codes allow a maximum static pressure of 80 psi.

E. Sanitary sewer, drainage and vent distribution systems:

1. Test entire sanitary, drainage, and venting systems by plugging all necessary openings, and filling systems with water to the level of the highest vent stack. Not less than ten feet of water pressure will be acceptable.Gravity sewer system leakage test shall be conducted in accordance with AWWA C600-82, Section 4.1. The duration of this test shall be for a minimum of two (2) hours.

2. Gravity sewer system leakage test shall be conducted in accordance with AWWA C600-82, Section 4.1. The duration of this test shall be for a minimum of two (2) hours.

F. Gas Distribution Systems:

1. Purge gas lines to equipment when the gas supply is turned on.

2. Test Preparation: Close each appliance valve or disconnect and cap each connected appliance.

3. General Systems:
   a. Inject a minimum of 150 psi of compressed air into the piping system for a duration of 4 hours and verify with a gauge that no perceptible pressure drop is measured.
   b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound.

4. Welded Pipes or Systems with Service Pressures Above 14 in-wc:
   a. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   b. Inject a minimum of 60 psi of compressed air into the piping system for a duration of 30 minutes and verify with a gauge that no perceptible pressure drop is measured.
   c. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound with 1 psi increments.

G. Test Results: Document and certify successful results, otherwise repair, document, and retest.

3.7 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with IPC and Local Health Department requirements.

B. Prior to starting work, verify system is complete, flushed, and clean.

C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

J. Test results shall indicate bacteriologically satisfactory water. Should any reports be unfavorable, the entire treatment and sampling process shall be repeated. Satisfactory test results shall be submitted to the appropriate health department or governmental agency as required.

3.8 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.

1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

3.9 LABELING AND IDENTIFYING

A. Comply with requirements in Section 22 0553 - Identification for Plumbing Piping and Equipment.

B. Comply with the requirements in Section 23 0553 - Identification for HVAC Piping, Ductwork and Equipment.

C. Install continuous plastic underground warning tapes during back filling of trenches for underground plumbing distribution piping. Locate tapes 6 inches below the finished grade, directly over the piping. Refer to Division 31 Section "Earth Moving" for warning-tape materials and devices and their installation.

D. Provide number 10 awg THWN tracer wire continuously along underground plumbing distribution piping. Locate and secure the tracer wire on top of the piping or within the pre-fabricated piping system. Terminate tracer wire at each end inside a round cast iron access frame and access cover flush with grade. Provide 12 inches of tracer wire inside the access frame to permit field connection.

3.10 PAINTING

A. Division 9 for painting interior and exterior natural-gas piping.

B. Comply with requirements in Section 22 0500 - Common Work Results for Plumbing.

C. Prime and paint exposed interior piping OSHA yellow. Do not paint flexible connectors.

D. Prime and paint exterior above-grade piping, and valves, regulators, meters and piping specialties OSHA yellow. Do not paint flexible connectors.

3.11 SCHEDULES

A. Refer to the drawings.

B. Pipe Hanger Spacing: In accordance with the IPC.

END OF SECTION 22 1005

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SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Backflow preventers.

B. Vacuum breakers.

C. Water pressure reducing valves.

D. Mixing valves.

E. Strainers.

F. Outlet boxes.

G. Hose bibbs.

H. Hydrants.

I. Drain valves.

J. Water-hammer arrestors.

K. Trap primers.

1.2 RELATED REQUIREMENTS

A. Section 22 0519 - Meters and Gauges for Plumbing Piping: Thermometers, pressure gauges, and water meters.

B. Section 22 1005 - Plumbing Piping: Pipe, fittings, and joints.

1.3 REFERENCE STANDARDS

A. ASSE 1001 - Performance Requirements for Atmospheric Type Vacuum Breakers; 2021.

B. ASSE 1003 - Water Pressure Reducing Valves for Potable Water Distribution Systems; 2023.

C. ASSE 1010 - Performance Requirements for Water Hammer Arresters; 2025.

D. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2023.

E. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2021.

F. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies; 2021.

G. ASSE 1015 - Performance Requirements for Double Check Backflow Prevention Assemblies; 2021.

H. ASSE 1017 - Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems; 2023.

I. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2023.

J. ASSE 1020 - Performance Requirements for Pressure Vacuum Breaker Assemblies; 2020 (Reaffirmed 2025).

K. ASSE 1024 - Performance Requirements for Dual Check Backflow Preventers; 2023.

L. ASSE 1044 - Performance Requirements for Trap Seal Primer - Drainage Types and Electric Design Types; 2023.

M. ASSE 1048 - Performance Requirements for Double Check Detector Backflow Prevention Assemblies; 2021, with Editorial Revision.

N. ASSE 1052 - Performance Requirements for Hose Connection Backflow Preventers; 2023.

O. ASSE 1053 - Performance Requirements for Dual Check Backflow Preventer Wall Hydrants - Freeze Resistant Type; 2019 (Reaffirmed 2023).

P. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.

Q. AWWA C510 - Double Check-Valve Backflow Prevention Assembly; 2017 (Reaffirmed 2021).

R. AWWA C511 - Reduced-Pressure Principle Backflow Prevention Assembly; 2017 (Reaffirmed 2021).

S. NSF 61 - Drinking Water System Components - Health Effects; 2025, with Addendum

T. NSF 372 - Drinking Water System Components - Lead Content; 2024.

U. PDI-WH 201 - Water Hammer Arresters; 2017.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on materials of fabrication, assembly of components, dimensions, ratings, finishes, rough-in requirements, and installed accessories.

C. Manufacturer's Instructions: Provide for products listed below. Include instructions for handling, protection, examination, preparation, and installation.

1. Reduced-pressure-principle backflow preventers.

2. Double-check valve backflow preventers.

D. Operation and Maintenance Data: Provide for products listed below.

1. Reduced-pressure-principle backflow preventers.

2. Reduced-pressure detector assemblies.

3. Double-check valve backflow preventers.

E. Project Record Documents:

F. Maintenance Materials: Furnish the following for Owner's use in project maintenance:

1. See Section 01 6000 - Product Requirements for additional provisions.

2. Extra Loose Keys for Hose Bibbs: Two.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

C. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

D. Store products under cover and protected from weather and dirt. Elevate above grade.

E. Protect end connections, flanges, threads, and grooves from dirt and damage.

F. Protect product interiors against rust and corrosion.

G. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products complying with NSF 61 and NSF 372.

B. Source Limitations: Furnish domestic water piping specialties of same kind by same manufacturer.

C. Provide brass-bodied domestic water piping specialties in DZR brass.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. NPS 2 and Smaller:
    a. Assembly: ASSE 1013 and AWWA C511.
    b. Backflow Valve: Manufactured from bronze, copper silicon alloy, or stainless steel.
    c. Isolation Valves: Ball valves on inlet and outlet.
    d. Maximum Working Pressure: 175 psi.
    e. Working Temperature Range: 33 to 180 degrees F.
    f. Accessories:
        1) Air gap fitting.
        2) Inlet strainer.

B. Double-Check Valve Backflow Preventers:

1. NPS 2 and Smaller:
    a. Assembly: ASSE 1015 and AWWA C510.
    b. Check Valves: Manufactured from bronze, copper silicon alloy, or stainless steel.

c. Isolation Valves: Ball valves on inlet and outlet.
d. Maximum Working Pressure: 175 psi.
e. Working Temperature Range: 33 to 180 degrees F.
f. Accessories:
1) Freeze sensor.
2) Inlet strainer.

C. Dual-Check Backflow Preventers:

1. Valve: ASSE 1024, brass, bronze, or copper silicon alloy.

2. Maximum Working Pressure: 175 psi.

3. Working Temperature Range: 33 to 140 degrees F.

2.3 VACUUM BREAKERS

A. Atmospheric Vacuum Breakers:

1. Valve: ASSE 1001, brass, bronze, or copper silicon alloy.

2. Maximum Working Pressure: 125 psi.

3. Working Temperature Range: 33 to 180 degrees F.

B. Hose-Connection Vacuum Breakers:

1. Valve: ASSE 1011, brass, nonremovable, drainable, with hose-thread end connections.

2. Maximum Working Pressure: 125 psi.

3. Working Temperature Range: 33 to 180 degrees F.

C. Pressure Vacuum Breakers:

1. Valve: ASSE 1020, bronze or copper silicon alloy.

2. Maximum Working Pressure: 150 psi.

3. Working Temperature Range: 33 to 140 degrees F.

2.4 WATER PRESSURE REDUCING VALVES

A. Direct-Acting Pressure Reducing Valves:

1. Manufacturers:
   a. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com/#sle.
   b. Flomatic Valves: www.flomatic.com/#sle.
   c. Wilkins by Zurn Water, LLC: www.zurn.com/#sle.

2. Valve: ASSE 1003, bronze or copper silicon alloy body, with spring-loaded diaphragm; field-adjustable outlet pressure, and integral inlet screen strainer.
   a. Diaphragm: EPDM or buna-nitrile.
   b. Spring: Stainless steel.

3. Maximum Working Pressure: 300 psi.

4. Outlet Pressure Range: 15 to 75 psi.

5. Working Temperature Range: 33 to 140 degrees F.

2.5 MIXING VALVES

A. Thermostatic Master Mixing Valves:

1. Valve: ASSE 1017, brass or bronze body; thermostatic element; corrosion- and lime-resistant internal components; integral locking temperature adjustment.

B. Water Temperature Limiting Valves:

1. Valve: ASSE 1070, brass or bronze body; thermostatic element; corrosion- and lime-resistant internal components; integral locking temperature adjustment with high-temperature limit stop; integral check valves with strainer screens on inlets.

2.6 STRAINERS

A. NPS 2 and Smaller:

1. Body: Wye-pattern in brass, bronze, or copper silicon alloy.

2. Screen: Stainless steel mesh.

3. Pressure Rating: 200 psi.

2.7 OUTLET BOXES

A. Washing Machine Outlet Boxes:

1. Description: Plastic preformed rough-in box with brass quarter-turn ball valves or single lever valve, socket for 2-inch waste, and slip-in finishing cover.

B. Ice Maker Outlet Boxes:

1. Description: Plastic preformed square or round rough-in box with quarter-turn ball valve and slip-in finishing cover.

2.8 HOSE BIBBS

A. Hose Bibbs:

1. Valve: Bronze or brass body with mounting flange, replaceable seat, hose thread spout, and integral or add-on vacuum breaker complying with ASSE 1011.

2. Operation:

3. Finishes:
   a. Exposed Locations in Finished Areas: Provide in polished chrome or polished brass.
   b. Service Areas: Provide in polished chrome, polished brass, rough chrome, or rough brass.

4. Maximum Working Pressure: 125 psi.

5. Working Temperature Range: 33 to 120 degrees F.

2.9 HYDRANTS

A. Wall Hydrants:

1. Assembly: ASSE 1011, ASSE 1019, ASSE 1052, or ASSE 1053.

2. Hydrant: Freeze-resistant, self-draining, wall-mounted.
   a. Valve: Bronze or brass body.
   b. Hose Connection: Threaded, with integral vacuum breaker or backflow preventer.
   c. Hose Connection Size: 3/4 inch.
   d. Installation: Recessed lockable box.
   e. Exterior Finish: Polished chrome.

3. Maximum Working Pressure: 125 psi.

4. Working Temperature Range: 33 to 120 degrees F.

2.10 DRAIN VALVES

A. Ball-Valve Hose-End Drain Valves:

1. Valve: Two-piece, full-port ball valve in brass or bronze with capped hose-end connection.

2. Pressure Rating: 250 psi.

3. Working Temperature Range: 33 to 140 degrees F.

B. Stop-and-Drain Valves:

2.11 WATER-HAMMER ARRESTORS

A. Piston Type:

1. Description: ASSE 1010 or PDI-WH 201, copper body with plastic piston and EPDM O-rings.

2. Air Preload Pressure: 60 psi.

3. Maximum Working Pressure: 150 psi.

4. Working Temperature Range: 33 to 180 degrees F.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Discard packing materials and verify product interiors are free from debris, damage, and corrosion.

B. Verify end connections, flanges, threads, and grooves are completely clean without signs of damage or degradation that could result in leakage.

C. For products containing isolation or shutoff valves, verify isolation and shutoff valves operate smoothly from fully closed to fully open.

3.2 INSTALLATION

A. Prior to installation of domestic water piping specialties, flush domestic water piping of foreign material.

B. Install products in accordance with manufacturer's instructions.

C. Install products level and plumb.

D. Install products with clearance for access and maintenance.

E. Support products NPS 2-1/2 and larger independently of surrounding pipe.

F. Support products with flanged or grooved ends independently of surrounding pipe.

G. For products containing isolation or shutoff valves, locate valves in horizontal piping with stems at or above center of piping, maintaining unimpeded stem movement.

H. Backflow Preventers:

1. Install backflow preventers in accordance with requirements of local authorities having jurisdiction, including requirements of local water utility.

2. Pipe relief from reduced-pressure-principle backflow preventers to nearest drain.

I. Water Pressure Reducing Valves:

1. Install shutoff valves on inlet and outlet.

2. Install pressure gauges on inlet and outlet.

J. Water Hammer Arrestors: Install in accordance with PDI-WH 201.

3.3 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Inspect each product for damage and defects.

C. Repair or replace damaged products.

D. Replace defective products.

E. For products containing isolation or shutoff valves, exercise isolation and shutoff valves from fully closed to fully open. Confirm smooth operation.

F. Backflow Preventers:

1. Test in accordance with manufacturer's instructions.

2. Test in accordance with requirements of authorities having jurisdiction.

3. Test in accordance with ASSE listing of backflow preventer.

4. Replace backflow preventers that fail testing.

G. Vacuum Breakers:

1. Test in accordance with manufacturer's instructions.

2. Test in accordance with requirements of authorities having jurisdiction.

3. Test in accordance with ASSE listing of vacuum breaker.

4. Replace vacuum breakers that fail testing.

H. Water Pressure Reducing Valves: Confirm outlet pressure remains steady without fluctuation.

I. Mixing Valves: Confirm outlet temperature remains steady without fluctuation.

J. Coordination of Other Tests and Inspections: Provide access to accommodate tests and inspections by independent testing agencies employed by Owner.

3.4 ADJUSTING

A. Adjust pressure reducing valves to design pressure set point.

B. Adjust mixing valves to design temperature set point.

3.5 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Clean products to remove dirt, paint, and other foreign materials.

C. Clean surfaces of products exposed to view in finished spaces to remove dirt, fingerprints, paint, and other foreign materials. Restore finishes to match original factory finish.

D. Clean surfaces of products exposed to view on building exterior to remove dirt, fingerprints, paint, and other foreign materials. Restore finishes to match original factory finish.

E. Clean strainers, including those internal to other products, prior to mm-dd-yyyy.

3.6 CLOSEOUT ACTIVITIES

A. Demonstrate operation, adjusting, and maintenance of the following to Owner's designated personnel.

3.7 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

END OF SECTION 22 1119

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SECTION 22 1319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Floor drains.

B. Cleanouts.

1.2 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping.

B. Section 22 1119 - Domestic Water Piping Specialties: Trap primers.

1.3 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASME A112.6.3 - Floor Drains; 2022.

C. ASME A112.36.2 - Cleanouts; 2022.

D. ASSE 1072 - Performance Requirements for Barrier Type Floor Drain Trap Seal Protection Devices; 2025, with Editorial Revision.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on fabrication materials, assembly of components, dimensions, ratings, finishes, rough-in requirements, and installed accessories.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

C. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

D. Store products under cover and protected from weather and dirt. Elevate above grade.

E. Store plastic products protected from direct sunlight.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS

A. Cast Iron Floor Drains:

1. Assembly: ASME A112.6.3.

2. Body: Lacquered cast iron with anchor flange and membrane clamping collar with weepholes.

3. Strainer: Adjustable, removable, with vandal-proof screws.

4. Accessories:
   a. Trap seal insert.
   b. Wide flange for bonding membrane floors.

2.2 CLEANOUTS

A. Floor Cleanouts:

1. Assembly: ASME A112.36.2.

2. Body: Lacquered cast iron.

3. Closure Plug: Bronze, threaded, gastight and watertight.

4. Top: Adjustable, with vandal-proof screws.
   a. Shape and Finish:
      1) All Locations, Unless Noted Otherwise: Round; nickel bronze.

5. Accessories:
   a. Clamp ring and flange for floors with waterproofing membrane.

B. Wall Cleanouts:

1. Assembly: ASME A112.36.2.

2. Body: Tee type; body material to match surrounding pipe.

3. Plug: PVC or ABS, threaded, gastight.

4. Access Cover: Round, stainless steel wall access cover with vandal-proof screw.

2.3 MISCELLANEOUS SANITARY WASTE PIPING SPECIALTIES

A. Floor Drain Trap Seals:

1. Assembly: ASSE 1072.

2. Description: Push-fit EPDM or silicone fitting with one-way-flow membrane or flapper.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Maintain continuity of waterproofing membranes. Secure waterproofing membranes to drain clamping collars and bonding flanges.

C. Install drains so strainers and grates are level and are at design elevation.

D. Extend cleanouts to finished floor or wall surface. Ensure clearance at cleanout for rodding or jetting of drainage system.

E. Install floor cleanouts to allow for floor finishes.

F. Locate, provide, and install cleanouts in piping in accordance with adopted code.

3.3 CLEANING

A. Clean debris from drains.

3.4 PROTECTION

A. Protect installed drains from accumulating dirt and debris through remainder of construction.

B. Protect installed products from damage due to subsequent construction operations.

END OF SECTION 22 1319

SECTION 22 1323 - SANITARY WASTE INTERCEPTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Oil and sand-oil interceptors.

1.2 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping.

B. Section 22 1319 - Sanitary Waste Piping Specialties.

1.3 REFERENCE STANDARDS

A. IAPMO/ANSI/CAN Z1001 - Standard for Prefabricated Gravity Grease Interceptors; 2021.

B. PDI G101 - Testing and Rating Procedure for Grease Interceptors; 2017.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on fabrication materials, assembly of components, dimensions, capabilities, rated flow rates, retention capacities, rough-in requirements, location and sizes of piping connections, service and access locations, and manufacturer-provided and field-installed accessories.

C. Shop Drawings: Provide for products listed below. Indicate interceptor assembly, including arrangements of adjacent sanitary waste and vent piping. Indicate clearances required for service and maintenance. Show inlet and outlet inverts for buried or recessed interceptors and for interceptors installed in sub-slab locations.

1. Oil and sand-oil interceptors.

D. Manufacturer's Instructions: Provide for products listed below. Include instructions for handling, protection, examination, preparation, and installation.

1. Oil and sand-oil interceptors.

E. Operation and Maintenance Data: Provide for products listed below.

1. Oil and sand-oil interceptors.

F. Project Record Documents: Indicate installed interceptor assembly, including adjacent sanitary waste and vent piping. Show inlet and outlet inverts for buried or recessed interceptors and for interceptors installed in sub-slab locations

1.5 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Furnish interceptors of same kind by same manufacturer.

2.2 OIL AND SAND-OIL INTERCEPTORS

A. Oil and Sand-Oil Interceptors, 100 gpm and Larger:

1. Body: Polyethylene

2. Service Access:
   a. Manholes: Minimum one per unit. Cast iron or steel-encased composite manhole covers, gasketed, gastight, and watertight; rated for minimum loading of 16,000 lb.

3. Accessories:
   a. Anchor kit.
   b. Lid extensions or risers.
   c. Manhole risers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field measurements are as indicated.

B. Verify rough-ins for field connections match sizes and locations shown on drawings.

C. Verify field piping connections are at inverts indicated on drawings.

D. Verify excavation, trenching, and bedding are complete and ready to receive equipment.

E. Verify anchoring slabs, foundations, and structures are ready to receive equipment.

F. Verify conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions, adopted code, and requirements of local authorities having jurisdiction.

B. Install interceptors level and plumb.

C. Refer to drawings and see Section 22 1005 for requirements for waste and vent piping to and from interceptors.

D. Support waste and vent piping independently from interceptors.

E. Vent interceptors in accordance with adopted code and with requirements of local authorities having jurisdiction.

F. Install interceptors with clearance for access and maintenance, including removal of sediment buckets, screens, and strainers.

3.3 FIELD QUALITY CONTROL

A. Test interceptors for leaks in accordance with manufacturer's instructions.

3.4 CLEANING

A. Clean debris from within interceptors.

B. Clean lids and manhole covers to remove dirt, debris, and other foreign material.

3.5 CLOSEOUT ACTIVITIES

A. Engage manufacturer's authorized representative to demonstrate maintenance procedures of interceptors to Owner's designated personnel.

3.6 PROTECTION

A. Protect installed interceptors from accumulating dirt and debris through remainder of construction.

B. Protect installed products from damage due to subsequent construction operations.

END OF SECTION 22 1323

SECTION 22 1500 - GENERAL-SERVICE COMPRESSED-AIR SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reciprocating air compressors.

B. System filters.

C. Air dryers.

D. Air receivers.

E. Pipe and fittings.

F. Unions and couplings.

G. Pressure reducing stations.

H. Air outlets.

1.2 RELATED REQUIREMENTS

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

B. Section 03 3000 - Cast-in-Place Concrete.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

D. ASME B31.1 - Power Piping; 2024.

E. ASTM B32 - Standard Specification for Solder Metal; 2020.

F. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

G. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 CONSTRUCTION SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.

C. Shop Drawings: Indicate piping system schematic with electrical characteristics and connection requirements.

1.5 CLOSEOUT SUBMITTALS

A. Test Reports: Submit inspector's certificate for air receiver for inclusion in Operating and Maintenance Manuals.

B. Manufacturer's Instructions: Indicate manufacturer's installation instructions, hoisting and setting requirements, starting procedures.

C. Operation Data: Submit for air compressor, air receiver, and accessories, aftercooler, refrigerated air dryer, and pressure reducing station.

D. Maintenance Data: Submit for air compressor, air receiver, and accessories, aftercooler, refrigerated air dryer, and pressure reducing station.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

F. Project Record Documents: Record actual locations of equipment and components. Modify shop drawings to indicate final locations.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements for additional provisions.

2. Extra Compressor Oil: One container, quart size.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Pressure Vessels: Comply with applicable code for installation of pressure vessels.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept air compressors, refrigerated air dryer on site in factory-fabricated containers with shipping skids and plastic pipe end protectors in place. Inspect for damage.

B. Protect piping and equipment from weather and construction traffic.

1.8 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide five year manufacturer warranty for reciprocating air compressors.

PART 2 PRODUCTS

2.1 RECIPROCATING AIR COMPRESSORS

A. Type: Simplex air compressor system with fixed belt-driven mechanism.

B. Capacity: 17 cfm of free air at 125 psi and _____ ft of altitude.

C. Electrically driven, air-cooled compressor unit; factory-assembled with air intake, intake filters, after-cooler, oil separator, oil cooler, moisture separator with drain trap, oil charging valve, gauges, sight glasses, vibration isolators, controls, and safeties.

D. Mounting: Tank mounted.

E. Receiver Accumulator Tank: 80 gal, mount compressor on horizontal aligned tank.

F. Electrical:

1. 5 hp at 208-VAC, 60 hz, TEFC motor, _____.standard magnetic starter.

2.2 SYSTEM FILTERS

A. Location: Downstream of air compressor.

B. Flow Capacity: Match compressor rate.

2.3 AIR DRYERS

A. Type: Self-contained mechanical refrigeration type complete with heat exchanger, refrigeration compressor, automatic controls, moisture removal trap, internal wiring and piping, and full refrigerant charge.

B. Air Connections: Inlet and outlet connections at same level, factory insulated.

C. Heat Exchangers: Air-to-air and refrigerant-to-air coils. Provide heat exchangers with automatic control system to bypass refrigeration system on low or no-load condition.

D. Moisture Separator: Centrifugal type located at discharge of heat exchanger.

E. Accessories: Air inlet temperature gauge, air inlet pressure gauge, on/off switch, high temperature light, power on light, refrigerant gauge, air outlet temperature gauge, air outlet pressure gauge.

F. Capacity: Coordinate rated flow to match compressor.

G. Electrical Characteristics:

1. 120 volts, single phase, 60 Hz.

H. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

I. Disconnect Switch: Factory mount disconnect switch in control panel.

J. Cord and Plug: Provide unit with 6 foot cord and plug for connection to electric wiring system including grounding connector.

2.4 AIR RECEIVERS

A. Receiver: Vertical, built to ASME regulations for working pressure of 125 psi. Flange or screw inlet and outlet connections.

B. Fittings: Adjustable pressure regulator, safety valve, pressure gauge, drain cock, and automatic float actuated condensate trap.

2.5 PIPE AND FITTINGS

A. Copper Tube: ASTM B88 (ASTM B88M), Type K, drawn temper.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

2. Joints: ASTM B32, solder, Grade Sn95.

2.6 UNIONS AND COUPLINGS

A. Mechanical Couplings:

1. Description: Removable and reusable, slide-on pipe coupling; fully gasketed; double-lip sealing system; anchoring ring; and wide-band, bolted clamping collar.

2. Housing, Clamping Collar, and Clamping Bars: Stainless steel.

3. Gaskets: Ethylene propylene diene monomer (EPDM).

4. Maximum Working Pressure: .

B. Unions:

1. Copper Tube and Pipe: 150 psi bronze unions with soldered joints.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

D. Flexible Connector: Neoprene with brass threaded connectors.

2.7 PRESSURE REDUCING STATIONS

A. Pressure Reducing Station: Consisting of automatic reducing valve and bypass and low pressure side relief valve and gauge. Provide oil separator where indicated.

B. Valve Capacity: Reduce pressure from 200 psi to 30 psi, adjustable upwards from reduced pressure.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. Install compressor unit on concrete housekeeping pad. See Section 03 3000.

C. Install compressor unit on vibration isolators. Level and bolt in place. See Section 22 0548.

D. Make air cock and drain connection on horizontal casing.

E. Connect condensate drains to nearest floor drain.

F. Install takeoffs to outlets from top of main, with shut off valve after takeoff. Slope takeoff piping to outlets.

G. Install compressed air couplings, female quick connectors, and pressure gauges where outlets are indicated.

H. Install tees instead of elbows at changes in direction of piping. Fit open end of each tee with plug.

3.2 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Compressed Air Piping Leak Test: Prior to initial operation, clean and test compressed air piping in accordance with ASME B31.1.

C. Repair or replace compressed air piping as required to eliminate leaks, and retest to demonstrate compliance.

D. Cap and seal ends of piping when not connected to mechanical equipment.

END OF SECTION 22 1500

SECTION 22 3000 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Commercial electric water heaters.

B. Diaphragm-type compression tanks.

1.2 RELATED REQUIREMENTS

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

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.

E. NSF 61 - Drinking Water System Components - Health Effects; 2025, with Addendum

F. NSF 372 - Drinking Water System Components - Lead Content; 2024.

G. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.

1.4 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data:

1. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on materials of fabrication, assembly of components, dimensions, weights, capabilities, performance, electrical characteristics, location and sizes of connections, service and access locations, and manufacturer-provided and field-installed accessories.

2. Provide type and size water hear. Indicate nominal capacity pressure and temperature ratings.

3. Provide certification that equipment and fittings comply with NSF 61 and NSF 372.

4. Provide energy efficiency AHRI Certificate.

C. Shop Drawings:

1. Provide plans and elevations showing equipment assembly, including fabrication and installation details. Show location and sizes of connections.

2. Indicate clearances required for service, access, maintenance, and replacement of internal components.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturer's qualification statement.

B. Project Record Documents: Record actual locations of components.

C. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1. For each product specified, provide components by the same manufacturer throughout.

2. The manufacturing company shall have local representation to provide continuing support for each piece of equipment.

B. Certifications:

1. Water Heaters: NSF approved.
   a. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF 61, NSF 372 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.
   b. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements.

2. Electric Water Heaters: UL listed and labeled to UL 174.

3. Water Tanks: ASME labeled to ASME BPVC-VIII-1.

4. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

5. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Performance:

1. All water heaters shall comply with the energy performance requirements of ANSI/ASHRAE/IESNA Standard 90.1 or international Energy Conservation Code (IECC) or local codes.

D. The contractor shall be responsible for any and all costs associated with any and all changes resulting from the use of a supplier other than the one used as the "basis of design".

1.7 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.8 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS:

A. General: Model numbers are provided in the articles below to set a standard for materials, quality of construction, options and details, and performance. Provide named products, or equal products by the acceptable manufacturers listed.

2.2 WATER HEATERS

A. Commercial Electric Water Heaters:

1. Type: Factory-assembled and wired, electric, vertical storage.

2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.

3. Performance: as shown on the drawings.

4. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.

5. Accessories:
   a. Drain valve.
   b. Temperature and Pressure Relief Valve: ASME labeled.

6. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in.

2.3 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psi, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

B. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 45 psig.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions required for applicable certifications.

B. Provide unions and isolation valves at each piece of equipment.

C. Provide each heater or storage tank with ASME rated temperature and pressure relief valves.

D. Electric Domestic Water Heater:

1. Set the heater on an equipment foundation (housekeeping pad). Plug all unused tappings.

2. Install level and plumb, according to drawings and referenced standards. Maintain manufacturer’s recommended clearances. Arrange units so that controls and devices are accessible.

3. Anchor water heaters to substrate.

4. Install and connect water heaters in accordance with applicable code.

5. Install temperature and pressure relief valves. Extend relief valve outlet with water piping in a continuous downward pitch and discharge to the closest floor drain.

6. Install vacuum relief valves.

3.2 FIELD QUALITY CONTROL

A. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front-end interface; see Section 25 1500.

3.3 CLEANING

3.4 START-UP

A. Hot water system shall be set for 140°F and pump to energize when return temperature drops below 110°F. Thermostatic balancing valves and shall be set to open when return temperature drops below 115°F.

3.5 DEMONSTRATION AND TRAINING

A. As specified in Section 22 0500 - Common Work Results for Plumbing, provide operating instructions.

B. Provide at least 1 hour of additional instruction time for the equipment specified in this section.

3.6 SCHEDULES

A. Refer to the drawings.

END OF SECTION 22 3000

SECTION 22 4000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Flush valve water closets.

B. Wall hung urinals.

C. Lavatories.

D. Sinks.

E. Supply stops.

F. Under-lavatory pipe supply covers.

G. Bi-level, electric water coolers.

H. Service sinks.

1.2 RELATED REQUIREMENTS

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

B. Section 22 1119 - Domestic Water Piping Specialties.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

C. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2008 (Reaffirmed 2013).

D. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).

E. ASME A112.18.1 - Plumbing Supply Fittings; 2024.

F. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).

G. ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2024.

H. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2024.

I. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2022.

J. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2022.

K. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.

L. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2021.

M. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

N. NSF 61 - Drinking Water System Components - Health Effects; 2025, with Addendum

O. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.4 CONSTRUCTION SUBMITTALS

A. Refer to the Division 01 requirements.

B. Product Data: Provide manufacturer's literature and data sheets for each product. Include materials of fabrication, rough-in requirements, location and sizes of connections, configurations, dimensions, finishes, features, and accessories.

1. Certifications: Provide products that comply with NSF 61 and NSF 372.

2. Provide a schedule of fixtures and trim proposed for use.

3. For water closets and urinals, submit documentation indicating gallons per flush (gpf).

4. For faucets, lavatories, sinks, aerators, and showerheads, submit documentation indicating gallons per minute (gpm).

5. For urinals and showerheads urinals and showerheads, submit data indicating Water Sense label.

6. Sustainability submittals: Provide LEED documentation. Comply with Section 018113.
    a. Water Efficiency Prerequisite 2: Indoor Water Use Reduction
        1) For water closet and urinal, documentation indicating flush rate in gallons per flush (gpf).
            (a) Urinals: Include documentation indicating WaterSense Label.
        2) For faucets, aerators, and showerheads, documentation indicating flow rate in gallons per minute (gpm).
            (a) Showerheads: Include documentation indicating WaterSense Label.
    b. MR Credit 2: Environmental Product Declarations
        1) Plumbing fixtures, if available.
    c. MR Credit 4: Material Ingredients
        1) Report: Plumbing fixtures, if available.

C. Shop Drawings:

1. Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, and connection types.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturer's Instructions: Indicate installation methods and procedures.

B. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements for additional provisions.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF 61 and NSF 372 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.

1. Acceptance product marking: NSF 61 and NSF 372 or other accepted certifier marks demonstrating third party certification with these requirements.

C. Fixtures shall be commercial grade of their respective kinds, free from flaws, cracks, craze or other imperfections, complete with fittings and connections.

D. Residential grade fixtures shall not be acceptable.

E. Fixtures manufactured by acceptable manufacturers are acceptable provided they are equal and similar to those specified.

F. Fixtures and trim where required to be accessible to disabled people, identified in this section as “for disabled,” shall comply with requirements of the Americans with Disabilities Act (ADA) Regulations, as applicable to each type of fixture or its use.

1. Trim must meet requirements for force of operation at water pressures up to 80 psi.

2. Water closet and urinal models must be selected and installed so that flush controls will be on the fixture’s open side.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on-site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.8 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide five year manufacturer warranty for electric water cooler.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. General: Model numbers are provided in the articles below to set a standard for materials, quality of construction, options and details, and performance. Provide named products, or equal products by the acceptable manufacturers listed.

B. Potable Water Systems: Provide drinking water system components certified as complying with NSF 61 and NSF 372.

C. ADA: Where indicated to be ADA-compliant, provide fixtures complying with ADA Standards and ICC A117.1.

D. Water Efficiency: EPA WaterSense label is required for all water closets, urinals, and lavatory faucets.

2.2 REGULATORY REQUIREMENTS

A. Comply with applicable codes for installation of plumbing systems.

B. Comply with National Energy Policy Act low flow standards for all fixtures.

C. Perform work in accordance with local health department regulations.

D. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

E. LEED Requirements:

F. Water Conserving Plumbing Fixtures: Provide water usage not to exceed, or to improve upon the following baselines for water conservation.
   a. Water Closets: 1.28 gallons per flush (gpf).
   b. Kitchen Sink Faucets: 1.5 gallons per minute (gpm) at 60 psi.
   c. Public Lavatory Sink Faucets: 0.5 gallons per minute (gpm) at 60 psi.

2.3 FIXTURES

A. Model numbers are intended to describe complete fixtures. Furnish all parts and fittings regularly required such as tailpieces for lavatory faucets, escutcheons, and appurtenances, including low-voltage devices and wiring for fixtures which require them to operate.

B. Fixtures shall be white except where another color is specified for a particular fixture. Refer to the architect for final color and finish selection prior to procurement.

C. Water closet and urinal models specified or noted to be accessible in accordance with ADA requirements: Select models such that flush controls will be on the fixture’s open side when fixtures are installed.

2.4 FLUSH VALVE WATER CLOSETS

A. Water Closets:

1. Vitreous china, ASME A112.19.2, floor mounted, siphon jet flush action, china bolt caps.

2. Bowl: ASME A112.19.2; 16.5 inches high with elongated rim.

3. Mounting Height: Refer to the drawings and schedule. Comply with ADA.

4. Flush Valve: Exposed (top spud).

5. Flush Operation: Sensor operated.

6. Handle Height: 44 inches or less.

7. Inlet Size: 1-1/2 inches.

8. Trapway Outlet: 4 inch.

9. Color: White.

10. Trim:
    a. Chrome-plated cast escutcheon, vandal-resistant stop cap, and ADA-compliant operation.
    b. Bolt Caps: Chrome-plated acorn nuts, size as required.

B. Flush Valves:

1. Valve Supply Size: 1 inch.

2. Valve Outlet Size: 1-1/2 inches.

3. Sensor-Operated:
    a. Type: ASME A112.19.5; chloramine-resistant clog-resistant dual-seat diaphragm valve complete with vacuum breaker, stops and accessories.
    b. Mechanism: Solenoid-operated piston or electronic motor-actuated operator with low-voltage powered infrared sensor, and mechanical override or override push button.
    c. Supplied Volume Capacity: 1.2 gal per flush.

4. Exposed Type: Chrome-plated, escutcheon, integral screwdriver stop.

C. Toilet Seats:

1. Plastic: White finish, open front, extended back, self-sustaining hinge, brass bolts, without cover.

2.5 LAVATORIES

A. Wall-Hung Basin:

1. Vitreous China, Grade A: ASME A112.19.2; white, rectangular commercial-grade sink with predrilled holes, rear-center drain, front overflow, and hanger. Size as indicated on drawings with 4-inch centerset spacing.

2. Carrier:
   a. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, bearing plate and studs.

B. Sensor Operated Faucet:

1. Spout Style: Standard.

2. Mixing Valve: None, single line for tempered water.

3. Water Supply: 3/8 inch compression connections.

4. Aerator: Vandal resistant, 0.5 gpm, laminar flow device.

5. Finish: Polished chrome.

C. Thermostatic Mixing Valve:

1. ASSE 1070 water temperature limiting valve.

2. See Section 22 1119 for mixing valve specifications.

3. Manufacturers:
   a. Substitutions: See Section 01 6000 - Product Requirements.

4. Braided hot and cold water supply lines.

2.6 SINKS

A. Single Compartment Bowl

1. ASME A112.19.3; _____ by _____ by _____ inch outside dimensions, 18 gauge, 0.050 inch thick, type 304 stainless steel, self-rimming and undercoated, with ledge back drilled for trim.

2. Drain: 1-1/2 inch chromed brass.

B. Faucets:

1. Single Handle Faucet with Two-Function Pulldown Spray Head:
   a. Type: Deck-mount, swivel faucet with mounting plate.

b. Spray Functions: Stream and aerated spray at 1.75 gpm, maximum.
c. Materials: Ceramic disc-cartridge valve on brass body with polished chrome finish.

2.7 SUPPLY STOPS

A. Description: ASME A112.18.1, quarter-turn full-port brass ball valve.

B. Operation: Handwheel or T-handle.

C. Finish: Polished chrome.

D. End Connections: Provide supply stops with end connections to match rough-in piping.

E. Maximum Working Pressure: 125 psi.

F. Working Temperature Range: 33 to 160 degrees F.

2.8 UNDER-LAVATORY PIPE SUPPLY COVERS

A. General:

1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.

2. Construction: 1/8 inch PVC with antimicrobial, antifungal and UV resistant properties.
   a. Comply with ASTM C1822 Type III for covers on accessible lavatory piping.
   b. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
   c. Comply with ICC A117.1.

2.9 BI-LEVEL, ELECTRIC WATER COOLERS

A. Water Cooler: Bi-level, electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, vinyl on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.

1. Capacity: 8 gph of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F, when tested in accordance with ASHRAE Std 18.

2. Electrical: 115 VAC, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring systemduplex receptacle connected to 20- Amp ground fault circuit interupting (GFCI) device to meet UL requirements. Where the GFCI device is inaccessible or concealed behind fixture provde GFCI breaker.

B. Bottle Filler: Materials to match fountain.

C. Accessories:

1. Supply: shutoff isolation valve and strainer.

2. Trim: P trap: McGuire No. 8090, 1.25 by 1.5 inch IPS outlet, cast-brass, ground joint, swivel type, with cleanout and complete with McGuire No. 2127, NPS 1-1/2 (DN 40) brass nipple with cast set screw escutcheon.

2.10 MOP SINKS

A. Material: Molded stone.

B. Dimensions: As indicated on drawings.

C. Accessories:

1. 5 feet of 1/2 inch diameter plain end reinforced plastic hose.

2. Hose clamp hanger.

3. Mop hanger.

2.11 SERVICE SINKS

A. Bowl: ASME A112.19.1; 22 by 18 by 12 inches deep, porcelain enameled interior cast iron roll-rim sink, with 12-inch high back, concealed hanger, chrome-plated strainer, stainless steel rim guard, cast iron P-trap with adjustable floor flange.

B. Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges.

C. Two-Lever Handle Service Faucet:

1. Type: Wall-mount vacuum breaker spout faucet with union inlets, 3/4 inch male hose thread outlet, and mounting plate.

2. Spray Type: Full stream spray at gpm as indicated on drawings, maximum.

3. ASME A112.18.1, ADA Standards, and NSF 61 compliant assembly.

4. Materials: Ceramic disc cartridge valve on brass body with polished chrome finish.

D. Accessories:

1. Mop hanger.
   a. Construction: 18-gauge, No. 302 stainless-steel mop hanger complete with slotted matching screws for mounting.
   b. Size: 36 inches long by 2 inches wide

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify walls, floors, and finishes are prepared and ready for installation of fixtures.

B. Verify rough-ins for field connections match sizes and locations shown on drawings.

C. Verify casework and countertops are prepared and ready for installation of fixtures.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install components level and plumb.

C. Secure fixtures in place.

D. Install rigid or flexible supplies to fixtures. Provide supply stops, reducers, and escutcheons.

E. Install new batteries in battery-powered fixtures at time of Date of Substantial Completion.

F. Wall Mounted Fixtures:

3.3 FIELD QUALITY CONTROL

A. Inspect each product for damage and defects.

B. Repair or replace damaged or defective products.

C. Test fixtures after installation to verify operation. Correct deficiencies.

1. In locations where fixtures are set against walls, seal crack between wall and fixture with silicon sealant.

D. Floor Mounted Water Closets:

1. The fixtures shall be secured over these bolts with Trim bolt caps.

2. The base shall be sealed to the floor using a clear silicone caulk.

E. Mop Sinks:

1. Install mop sinks as recommended by manufacturer with space between basin and wall completely filled with a waterproof silicon sealant.

2. Provide P trap.

3.4 ADJUSTING

A. Adjust stops and valves so fixtures operate without splashing, noise, or overflow.

B. Adjust sensor range on sensor-operated fixtures.

3.5 CLEANING

A. Clean plumbing fixtures to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

3.7 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Protect plumbing fixtures and board them over so that they cannot be used until final acceptance of the work.

C. Do not permit use of fixtures by construction personnel.

D. Detect no leaks at any water-using fixture, appliance or equipment.

END OF SECTION 22 4000

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SECTION 22 4500 - EMERGENCY PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Safety stations (combination emergency fixture units).

B. Emergency-fixture water-tempering system.

1.2 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2014, with Editorial Revision (2020).

1.3 CONSTRUCTION SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's catalog sheets for fixtures, fittings, accessories, and supplies.

1.4 CLOSEOUT SUBMITTALS

A. Field Test Reports: Plumbing fixture operational tests.

PART 2 PRODUCTS

2.1 SAFETY STATIONS (COMBINATION EMERGENCY FIXTURE UNITS)

A. Manufacturers:

1. Encon Safety Products, Inc; _____: www.enconsafety.com/#sle.

2. Guardian Equipment; _____: www.gesafety.com/#sle.

3. Haws Corporation; _____: www.hawsco.com/#sle.

B. ANSI Z358.1, Barrier-free Recessed Safety Center:

1. Waste Drain: Internally piped from eye wash to built-in drain collection pan.

C. ANSI Z358.1, free-standing shower with bowl-mounted eye/face wash spray head fixture assembly.

D. Tepid Supply Water Temperature: Set to 85 degrees F.

E. Water Supply Connection Size: Minimum, 1-1/4 inch.

F. Water Discharge Flow Rates:

1. Shower Head: Minimum, 20 gpm at 30 psi for 15 minutes.

2. Eye/face wash Spray Heads: Minimum, 3 gpm for 15 minutes.

G. Pipe and Fittings Material: Powder coated galvanized steel.

H. Shower Head:

1. Self-cleaning, non-clogging, 10 inches in diameter with escutcheon.

2. Flow Pattern: Minimum, 20 inches at 60 inches above floor end.

I. Valves: Full flow, self closing, quick to open within one second using dedicated manual panic bar operator for shower and dedicated manual panic bar handle for eye/face wash.

2.2 EMERGENCY-FIXTURE WATER-TEMPERING SYSTEM

A. Manufacturers:

1. Encon Safety Products, Inc; _____: www.enconsafety.com/#sle.

2. Guardian Equipment; _____: www.gesafety.com/#sle.

3. Haws Corporation; _____: www.hawsco.com/#sle.

B. Tepid Water Temperature: Set to 85 degrees F.

C. Capacity: Sized to match selected fixture(s) capacity at 30 psi supply pressure.

D. Above-freezing, Chemical-resistant System:

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that fixtures and accessories are of the correct type and size prior to installation.

B. Verify that deck, wall and floor finishes are prepared and ready for fixture installation.

3.2 INSTALLATION

A. Install fixtures and fittings in accordance with the manufacturer's instructions.

B. Adjust water flow rates to comply with manufacturer's rating of the fixture.

C. Place remote-activated thermostatically actuated bleed valve behind wall or above ceilng.

3.3 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Operational Tests: Upon completion and sterilization of plumbing systems, conduct operating tests to demonstrate satisfactory, functional, and operating efficiency.

3.4 CLEANING

A. Thoroughly clean plumbing fixtures and equipment.

3.5 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Repair or replace products damaged before Date of Substantial Completion.

END OF SECTION 22 4500

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SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section applies to all Division 23 Sections of this project except as specified otherwise in the individual sections and here-in. Work described in this section includes general requirements common to all mechanical and HVAC systems. Provisions of this section apply to all mechanical specification sections.

B. Requirements of this section apply to new work unless otherwise indicated.

1.2 DEFINITIONS

A. The use of the word "PROVIDE" in the specifications and on drawings for work under this section shall mean: Furnish and install complete, supplying all necessary labor and materials.

1.3 JOB CONDITIONS

A. The drawings show the general scope and arrangement of the HVAC systems and shall be followed as closely as actual conditions allow.

B. Give consideration to all other trades. Make arrangements to avoid conflicts and interference with other work. Fully coordinate all components of HVAC systems with minor adjustments as required, including the provision of offsets, transitions, fittings, and accessories to meet actual conditions.

1.4 CONFORMANCE TO REGULATIONS

A. All work shall conform to the regulations of the applicable federal, state, and local, laws, ordinances, and codes.

B. All electrical work required under this Contract shall comply with the National Electrical Code and shall meet all local requirements.

1.5 REGULATORY REQUIREMENTS

A. All products shall be listed by the Underwriters Laboratories, Inc. (UL), and shall bear the UL label. Where UL labels are not provided from the factory, the contractor shall be responsible for having the equipment or materials tested by a UL testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and shown.

B. The installation of the systems covered by these specifications shall conform to all applicable requirements and recommendations of the N.F.P.A. These requirements are minimums and shall be complied with at no additional cost to the Owner.

C. In the absence of local regulation and codes, on heating, ventilating, or air conditioning, or in items or circumstances not covered by local regulation and codes, all recommendations and requirements of the ASHRAE, as set forth in the current edition of the ASHRAE Guide, shall be met as well as all requirements and recommendations of NFPA 90A and the International Building Code.

D. All gas products and equipment is to be AGA certified.

1.6 QUALITY ASSURANCE

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. Work shall meet or exceed minimum recommendations of:

1. AGA - American Gas Association

2. ANSI - American National Standards Institute

3. ASME American Society of Mechanical Engineers

4. ASHRAE - American Society of Heating Refrigeration and Air-Conditioning Engineers

5. ASPE - American Society of Plumbing Engineers

6. ASTM - American Society for Testing and Materials

7. AWS - American Welding Society

8. USDOE - United States Department of Energy

9. EPA - Environmental Protection Agency

10. ICC - International Code Council: model codes as adopted by the local Authority Having Jurisdiction (AHJ).
    a. IBC - International Building Code (current adopted edition)
    b. IECC - International Energy Conservation Code (current adopted edition)
    c. IMC - International Mechanical Code (current adopted edition)

11. NFPA - National Fire Protection Association

12. NEMA - National Electrical Manufacturers Association

13. NIOSH - National Institute for Occupational Safety and Health

14. NSF - National Sanitation Foundation

15. OSHA - Occupational Safety and Health Act

16. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association

17. TIMA - Thermal Insulation Manufacturers Association

18. UL - Underwriters' Laboratories

C. Reference to the standards of any technical society, organization, or association, or to the laws, ordinances, or codes of governmental authorities shall mean the latest standard, code, or specification adopted, published, and effective at the date of taking bids.

D. The specifications, codes, and standards referenced in these specifications (including addenda, amendments, and errata) shall govern in all cases where references thereto are made. In case of conflict between the referenced specifications, the more stringent requirement shall govern unless otherwise permitted by the A/E. Major conflicts shall be referred to the A/E for resolution.

E. The contractor shall be responsible for any and all costs associated with any and all changes resulting from the use of a supplier other than the one used as the "basis of design".

1.7 PERMITS, LICENSES, AND FEES

A. Where requirements of the drawings and specifications exceed code requirements, the work shall be provided in accordance with the drawings and specifications. Any work provided contrary to these requirements shall be removed and replaced at the Contractor's expense.

B. The Contractor shall obtain and pay for all necessary permits and inspections required for the installation of this work and shall pay all charges incident thereto. The Contractor shall deliver to the A/E all certificates of said inspections issued by the authorities having jurisdiction

1.8 MATERIALS AND EQUIPMENT

A. The contractor's attention is directed to the intention of the specifications to provide domestic manufactured products only for this project. Where non-domestic products will only be considered on a individual product basis and will only be accepted if prior approval is received before the project is bid.

B. Unless specifically provided otherwise, all materials and equipment furnished for permanent installation in the Work shall conform to applicable standards and be new, current design, unused, and undamaged and free from flaws and defects of any nature.

C. Individual parts shall be manufactured to standard sizes and gauges so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate equipment shall be interchangeable.

1.9 WORKMANSHIP

A. All work shall be performed by skilled mechanics, under competent supervision, employing latest and best practices of the trade. Work shall be installed in accordance with recommendations of ASHRAE Guide, and equipment manufacturer's installation instructions. In the event there is any conflict or doubt, consult A/E for clarification and approval.

1.10 UTILITIES AND CONNECTIONS

A. Verify the location of all existing utilities before laying out and making connections. Report any inconsistencies to A/E before commencing work. The Contractor shall be responsible for any error resulting from failure to exercise these precautions.

1.11 ELECTRICAL WORK

A. Electrical equipment and wiring shall conform to the requirements of Division 26 - Electrical.

B. Electrical Contractor will provide the following for the mechanical equipment:

1. A source of power as required for each electric motor and for each electrical heating and cooling item of equipment installed under the mechanical contract, including final wiring connections to motor terminals or to terminals in a control panel mounted on each respective unit.

2. Circuit breaker protection as required for each electric heating and cooling item of equipment installed under the mechanical contract.

3. Wiring each electric motor-driven equipment and each electrical heating and cooling item of equipment (where applicable) through a magnetic starter or a magnetic contactor, integral motor starter where indicated, and controls furnished by the Mechanical Contractor.

4. Wiring of each exhaust fan through a wall switch furnished by the Electrical contractor.

5. Manual or automatic control and protective or signal devices required for the operation specified herein, and any control wiring required for control devices but not shown on the electrical plans shall be provided under this Section.

C. In the event Mechanical Contractor proposes to use any items of mechanical equipment which have sizes, numbers of electrical meters, or other electrical requirements different from those specified on schedules, drawing, or elsewhere, Contractor shall be responsible for coordinating these changes with the Electrical Contractor and he shall reimburse the Electrical Contractor for all additional costs necessitated by these changes.

D. In general, the Electrical Contractor will do all power wiring for the mechanical equipment as described above, and the Mechanical Contractor shall do all low voltage (24V) control and interlock wiring, unless otherwise specified or indicated on drawings.

E. Consult electrical drawings for the extent of electrical work provided for the mechanical equipment. Verify current characteristics with Electrical Contractor before ordering any equipment for this project.

F. Mechanical Contractor shall provide all other wiring not covered above, that is necessary for complete and operating heating and air conditioning systems for the building, including all control wiring, interlock wiring, conduit, relays, controls, starters, disconnect switches, circuit breakers, control conduit and outlet boxes, wiring of all applicable control items of equipment, and other electrical work as required.

1.12 WIRING DIAGRAMS

A. All mechanical equipment shall be provided with complete wiring diagrams showing all power and control connections. The diagrams shall be placed in a clear plastic pouch that is permanently affixed to the equipment.

1.13 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Refer to Division 01 requirements.

B. Temporary Storage:

1. Maintain upon premises, where directed, a storage area, and be responsible for all contents within these areas. Provide all security measures necessary for this area.

2. Area shall be maintained and shall be returned to original condition at the completion of the project.

C. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.

2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.

3. Provide walk-off mats at entries and replace them at regular intervals.

4. Construct dust partitions, where indicated on the drawings or as required.

5. Seal off all return air registers and other mechanical systems to prevent dust from entering.

D. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.

2. Protect finished work from damage, defacement, staining, or scratching.

3. Protect finishes from cleaning agents, or grinding and finishing equipment.

4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.

5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

E. Repair all damage or soiling to the complete satisfaction of the A/E; replace any materials or work damaged to such an extent that they cannot be restored to their original factory finish condition, all at no addition to the Contract Sum.

F. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.

2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer’s recommended temperatures.

G. Cover all ductwork stored on site, including exposed ends of installed ductwork.

H. All equipment shall be covered during shipping and wrapped prior to leaving the factory.

I. Do not install wet or water-damaged materials.

J. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.14 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

1.15 SUBSTITUTIONS

A. Refer to Division 01 requirements.

B. Only base manufacturer's equipment has been investigated and determined to meet necessary space conditions. It shall be the responsibility of the approved equal manufacturer and contractor to verify their suitability for use on this project.

C. Specific reference in the specifications to any article, device, product, material, fixture, form or type of construction, etc., by name, make, or catalog number, with or without the words "or equal" shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition, and the Contractor in such cases may at his option, use any article, device, product, material, fixture, form or type of construction, which in the judgement of the A/E, expressed in writing prior to bidding as specified below, is equal to that herein named.

D. Being listed as an approved equal manufacturer means only that the listed manufacturer is basically a reputable supplier whose equipment will receive consideration if in accordance with ll document requirements including space limitations and deliver. Being listed is not to be construed as indicating nor implying that the supplier's product is assured of being acceptable for the project. The burden

of developing a product to comply with the documents and of obtaining approval of the product rests solely with the Contractor.

E. For a Product specified by naming one or more manufacturer and model, and followed with the statement “or approved equal,” the Contractor may submit a Product other than the Product specified by manufacturer and model, that Product shall be considered a Substitute Product and shall comply with the following conditions:

1. The Contractor shall verify the Substitute Product is equal or superior in all respects to the Specified Product.

2. The Contractor shall submit data on the Substitute Product in compliance with the “Submittals” paragraph herein.

3. After the Substitute Product has been approved by the A/E, the Contractor shall be responsible for coordinating the installation of the Substitute Product with all trades. The Contractor shall be responsible for any changes required to incorporate the Substitute Product into the Work.

4. The Contractor waives all claims for additional costs related to the Substitute Product that becomes apparent before, during or after installation.

1.16 PROJECT RECORD DOCUMENTS

A. Refer to Division 01 requirements.

B. Contract Documents: Maintain on site one set of the following record documents; record actual revisions to the work of this division:

1. Contract drawings.

2. As-Built record documents and shop drawings: Legibly mark each item to record actual construction, including:
   a. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   b. Measured locations of internal utilities and appurtenances concealed in construction ,referenced to visible and accessible features of the work.
   c. Field changes of dimension and detail.
   d. Details not on original Contract Drawings.

3. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:
   a. Manufacturer’s name and product model and number.

b. Product options, substitutions, or alternates utilized.
c. Changes made by addenda and modifications.

4. Addenda.

5. Change orders and other modifications to the Contract.

6. Reviewed shop drawings, product data, and samples.

C. Maintain record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Submit documents as specified in Division 01.

1.17 OPERATING AND MAINTENANCE MANUAL

A. Refer to Division 01 requirements.

B. General: The Contractor shall submit one digital copy of the Operation and Maintenance Manual to the A/E for review a minimum of 60 days prior to Instruction and Training Sessions. This copy will be returned to the Contractor with A/E's comments or approval. The Contractor shall revise and resubmit, as required, one digital copy of the O&M Manual. Instruction and Training Sessions shall begin 30 days after receipt of the final approved O&M Manuals. Refer to “Instruction and Training Sessions” paragraph herein.

C. Electronic Binders (digital): Include cover page stating '(PROJECT NAME) OPERATION AND MAINTENANCE MANUAL'; applicable volume number; and project title.

1. Provide a table of contents for the entire manual and insert at the front of each binder.

2. Provide tabbed bookmarks for each Product and system, with typed description or applicable Specification Section.

D. Submit sets before final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to the requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.

E. Laminated Asset Schedules: documents including, but not limited to, the following:

1. Equipment Log: Provide a comprehensive log for all mechanical equipment provided for the project. Mechanical equipment log shall identify the following in an 8.5 x 11 landscape format:
   a. Unit ID or designation or mark number.
   b. Equipment manufacturer.
   c. Manufacturer's model number.
   d. Serial number.
   e. Equipment location.
   f. Location of area(s) served.
   g. Electrical data (voltage, phase, HZ, etc.).
   h. Equipment Heating and/or Cooling Capacity (MBH,kW, Tons, or Motor HP).
   i. Water or Air Flow capacity (GPM@' WG or CFM @" WG).
   j. Belt sizes, where applicable.
   k. Filter sizes, where applicable (##" x ##" MERV-#).
   l. Additional information, as requested by the Owner.
   m. Sample Equipment Log below for reference: As shown similar to the SD report.

Unit ID Mark	MFR	Model	Serial	Eqpt Location	Service Location	Volts-Phase	FLA A	Capacity	Flow CFM @ SP	Belts	Filter	Notes
Pump						460V-3PH		## HP	## GPM @ ##' WG		-	
Fan						460V-3PH		## HP	## CFM @ ##" W		-	
Boiler						460V-3PH		## MBH	## GPM @ ##' WG		-	
Chiller						460V-3PH		## Tons	## GPM @ ##' WG		-	
AHU/ RTU/ DOAS						460V-3PH		## Tons	## CFM @ ##" WG		#"x#" MERV-#	

VRF						208V-1PH		## Tons	## CFM @ ##" WG		#"x#" MERV-#	
FCU						208-1PH		## Tons	## CFM @ ##" WG		#"x#" MERV-#	
UH								kW	## CFM @ ##" WG		-	

2. Belt Schedule: Prepare a consolidated belt schedule for each piece of mechanical equipment that requires a belt.
   a. Types of belts required.
   b. Quantity and locations of belts for each equipment.
   c. Frequency of belt changes.

3. Lubrication Schedule: Prepare a lubrication charts for each piece of mechanical equipment that requires grease or oil.
   a. Types of lubricants required.
   b. Locations of lubrication points.
   c. Frequency of lubrication.

4. Filter Scheule: Refer to 23 4000 - HVAC Air Cleaning Devices for additional information.
   a. Types of filter required.
   b. Quantity and locations of filter for each piece of equipment.
   c. Frequency of filter changes.

5. Provide one extra set of belt, lubrication, and filter charts mounted in plastic covers, besides those required in Operating and Maintenance Manuals at each mechanical room and/or closet.

F. Contents: The manual shall consist of three parts as follows:

1. Part 1: Directory listing names, e-mail addresses, telephone numbers, and company of Architect, Engineer, Contractor, Subcontractors, and major equipment suppliers.

2. Part 2: Operation and maintenance instructions including, but not limited to, the following:
    a. General description and specifications of each component and of each system as a whole.
    b. Manufacturer's catalog description of each component supplemented by approved equipment submittals.
    c. Detailed electrical and logic descriptions.
    d. Installation and start-up instructions, including complete calibration procedures for each component and for the system as a whole.
    e. Operating instructions including:
        1) Equipment and Systems Performance Test Report
        2) Sequence of operation
        3) Shutdown procedure
        4) Emergency operating procedures
    f. Trouble shooting guide with service instructions
    g. Preventive maintenance schedules
    h. Parts list with names, addresses, and telephone numbers of local parts suppliers.
    i. names, addresses, and telephone numbers of nearest service organizations
    j. Interface requirements and capabilities.
    k. Detailed schematics of equipment.
    l. Complete equipment schedules.

3. Part 3: Project documents including, but not limited to, the following:
    a. Start-up Report.
    b. Testing, adjusting, and balancing report
    c. Certificates
    d. Equipment and Systems Performance Test Report
    e. Commissioning Report.
    f. Copies of warranties and guarantees.

G. Quality: The manual will be reviewed by the A/E to determine the accuracy, completeness, and quality of printing. Deficiencies will necessitate resubmittals by the Contractor. Refer to “Submittals” paragraph herein.

1.18 INSTRUCTION AND TRAINING SESSIONS

A. Refer to Division 01 requirements.

B. After all equipment and services are in operation and receipt of the approved Operation and Maintenance Manuals, Instruction and Training Sessions shall be conducted for representatives of the Owner.

C. Instruction Session shall be conducted during the Owner's normal working periods and at times satisfactory to the Owner.

1. Session shall be sufficient to address all instruction and training for the installed systems and shall last not less than one 8-hour working day.

D. The Training Session shall address the operation and maintenance of each piece of equipment and of the system as a whole. Preventative maintenance techniques shall be included.

E. Instructions and training shall be given by competent, factory-trained service and operating personnel from the appropriate manufacturer(s). The Contractor shall record the names of all personnel present at each Instruction and Training Session and shall forward a copy of the attendance log to the A/E within seven days after each session.

1.19 PROJECT/SITE CONDITIONS

A. Install work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of A/E before proceeding.

1.20 WARRANTIES

A. Refer to Division 01 requirements.

B. Manufacturer Warranty: Supply manufacturer's standard warranty against defects in product workmanship and materials. Provide a minimum of one (1) year manufacturer warranty for all equipment. Complete forms in Owner's name and register with the manufacturer. Refer to individual Sections for other requirements.

C. Installer Warranty: Provide a minimum of one (1) year warranty for all installations commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with the installer.

1. To correct defects in workmanship, new materials, new equipment, and the operation of the system for a period of one year from the date of acceptance. Equipment and materials, repaired or replaced are guaranteed for one year following the date of correction.

2. To repair any damage to building and equipment resulting from defects in workmanship, materials, equipment, and system operation.

3. To remove any item not specified or given approval and replace it with the specified or approved item.

4. Any item submitted for approval that does not conform to these specifications shall have an accompanying note of exception.

5. That the system as installed shall comply with code requirements.

6. Provide service log on all equipment repairs to the Owner at the end of the warranty period.

D. Warranty periods shall begin from Date of Substantial Completion.

E. When use of the permanent equipment has been permitted for temporary heating or ventilation of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

1.21 CONTRACTOR COORDINATION

A. Nomenclature for final room names and numbers may vary from the construction documents. Final names and numbers used in the shop drawings shall be coordinated with final room names and numbers assigned by the Owner and A/E.

B. HVAC contractor(s) shall coordinate their work with all other trades prior to fabrication of systems and commencement of installation. It shall be the responsibility of each contractor to review the work of other trades (including, but not limited to civil, structural, architectural, fire alarm, fire suppression, plumbing, and electrical) as it affects their work, and as their work affects other trades, to insure that the construction documents are closely followed. Where discrepancies arise, they shall be referred to the A/E for resolution before proceeding with the Work.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. All equipment and materials provided under this section of the specifications shall be new and of the best grade and quality. Materials and equipment manufactured outside of the United States will not be acceptable.

B. The approval of the A/E shall be obtained by the Contractor on all equipment and materials before any installation is made.

C. Equipment that is installed and then does not perform as represented by selection data or shop drawings shall be replaced with equipment that meets the job requirements and specifications at no additional cost to the Owner.

D. All equipment, materials, and work indicated on the drawings or as specified hereinafter is intended to be installed in a manner conforming to the best engineering practices and all equipment is intended to be complete in every respect to satisfy the job requirements and this specification. In the event any material or equipment is indicated to be used or installed contrary to the manufacturer's recommendations, or if any part, control accessory or auxiliary item required for satisfactory and proper operation and performance of the material and/or equipment is not indicated or specified, it shall be the Contractor's responsibility to notify the A/E in writing prior to installation. In the event the Contractor fails to give such notice, he will be required to correct the work and/or furnish items omitted (in the performance of his work) at no increase in the contract sum.

E. Upon request from the A/E, the Contractor shall furnish to the A/E a certification on all materials and equipment so designated by the A/E. The certification shall be made by the manufacturer of the material and/or equipment; shall be signed by an official of the manufacturing concern; and shall state that the drawings, specifications, and project requirements have been thoroughly studied by the manufacturer and that the proposed material and/or equipment is unconditionally guaranteed to operate and/or perform properly as applied.

2.2 FIRESTOPPING MATERIALS

A. Refer to Division 07 for more information.

B. Manufacturers:

1. 3M; CP-25 caulk system.

2. Chase Technology Corp; Chase-Foam.

3. Dow Corning; Silicone RTV Foam (3-6548 Silicone).

C. Where permitted by Code, fire-rated mineral wool may be used for applications approved by the A/E.

2.3 FLOOR, WALL, AND CEILING PLATES

A. Finished Exposed:

1. All piping or duct passing through or into floors, walls, partitions, and ceilings shall be provided with escutcheon plates of flanges. The plates or flanges shall fit snugly around the pipe, or the pipe insulation for insulated lines, and shall cover completely the pipe opening and sleeves. Plates shall be fabricated of a minimum 16-gauge galvanneal as appropriate to allow field painting. All plates shall be painted to match the surrounding finish.

B. Unfinished Areas:

1. Construction: plates or flanges shall be constructed of not less than 16-gauge galvanized sheet metal.

2. Equipment rooms with furred ceilings will be considered as unfinished areas

2.4 ACCESS PANELS

A. Refer to the A/E division specifications.

2.5 PAINTING

A. Refer to Division 09 requirements. All finish painting shall be performed under another section of the specification, except as specified otherwise in this section of the specification.

B. All factory-applied finishes on equipment and materials that are damaged in any fashion shall be restored to their original finish in a manner as approved by the A/E.

PART 3 - EXECUTION

3.1 GENERAL

A. Unless otherwise noted, install equipment in accordance with the manufacturer's printed instructions for the application indicated.

B. Install, operate, and adjust systems in accordance with the plans and specifications.

C. All work for this division shall conform to the regulations of the applicable federal, state, and local laws, ordinances, and codes.

D. A Request For Information (RFI) shall be submitted to the A/E for any portion of the Work that the Contractor determines a clarification is required. Prior to submitting a RFI the Contractor shall thoroughly research the Contract Documents to ensure the information has not been overlooked. The RFI shall include references to the portion of the Contract Documents that requires clarification. The Contractor shall allow a minimum of five (5) business days for the A/E to respond to the RFI. The

Contractor shall not proceed with that portion of the Work until a response has been returned.

E. All Products delivered to the site(s) shall be stored in accordance with the manufacturer's printed instructions. If a manufacturer does not have printed instructions then the Product shall be adequately housed and otherwise protected against damage or corrosion. If any Product stored at the site(s) is not protected as specified herein, the Contractor shall not receive payment for that Product. That Product shall be stored by the Owner at the expense of the Contractor. Any Product damaged as a result of failure to comply with this requirement shall be replaced by the Contractor at no additional cost to the Owner.

F. Temporary Conditioning: During construction and renovations, the HVAC systems shall be turned off, and all supply, return, and equipment openings shall be covered. If the area of construction or renovation requires heating or cooling during the project, it shall be the responsibility of the contractor to provide and install temporary HVAC systems to meet this need, during the installation of permanent systems. Only when the project is complete shall the building HVAC system’s operation be restored.

1. Air filters to be replaced at substantial completion prior to testing and balancing procedures.

2. If equipment, ducts, and/or coils need cleaning, it shall be the responsibility of the contractor.

3.2 ACCESSIBILITY

A. Locate all equipment that must be serviced, operated, or maintained in fully accessible positions in accordance with the manufacturer's recommendations and subject to the approval of the A/E. Provide a minimum of two feet of clearance in front of equipment access doors and components requiring service.

B. Access panels shall be provided for access to all equipment, valves, dampers, specialties, and accessories. Dampers with operating control through the ceiling will not require access.

C. The panels shall be located as indicated on the drawings and/or as required for adequate access. The exact locations of the access panels shall be as approved by the A/E.

3.3 FIRESTOPPING

A. Refer to Division 07 requirements.

B. For all penetrations or openings in or through fire-rated assemblies including, but not limited to, walls, floors, ceilings, shafts, etc. the Contractor will provide approved UL listed "through penetration firestop" systems to ensure the integrity of the rated assembly. Refer to architectural drawings and details for approved options and confirm the final selection with A/E before proceeding with this portion of the Work.

C. Firestopping in the mechanical room shall be recessed 3/4-inch on both sides and shall be sealed on both sides with 3/4-inch of acoustical sealant.

D. All fire-stopping systems shall be installed in strict compliance with the manufacturer's instructions for compliance with UL listings.

3.4 PROTECTION OF OPENINGS

A. General Contractor shall provide framed openings in roofs and walls as required for exhaust fans, louvers, and outdoor units. Mechanical Contractor shall coordinate with General Contractor and provide General Contractor with sizes and locations of these and all other necessary penetrations well in advance. Failure to do so will result in the Mechanical Contractor bearing the cost of this phase of the work.

B. Where walls are penetrated for louvers, ducts, or vents, appropriate lintels shall be provided to support the structure and shall comply with the requirements of the structural drawings and specifications.

C. The Mechanical Contractor shall provide all roof curbs for this installation and General Contractor will flash all roof curbs and penetrations per the roofing manufacturer’s requirements.

D. The Mechanical Contractor shall provide all roof equipment support rails for this installation and General Contractor will flash all support rails and penetrations as detailed on the drawings.

E. Openings in partially installed systems, including equipment and piping, shall be plugged, capped, or otherwise closed with approved methods and materials or devices until connections are made.

3.5 PROTECTION FROM MOVING PARTS

A. Belts, shafts, couplings, and other rotating or moving parts, located so that any person may come in proximity thereto, shall be fully enclosed or properly guarded.

3.6 ELECTRICAL COORDINATION

A. Mechanical equipment, piping, and ductwork shall be installed with clearances to electrical switchboards, panelboards, power panels, motor control centers, and transformers. The clearances shall be the greater of the requirements of the latest edition of (Articles 384-2 and 110-6 or 110-34) or 3'-6" in front of the equipment. Mechanical equipment, ductwork or piping shall not be installed directly over the electrical gear and not less than 3'-0" horizontally from the top of the electrical gear.

3.7 PAINTING

A. Where colors or finishes are specified to match adjacent surfaces and the colors or finishes of the product installed do not match the contractor shall repaint or refinish as required to accomplish the desired effect, as approved by the A/E.

3.8 QUALITY ASSURANCE

A. All items shall be properly lubricated and in perfect operation upon completion of the project and prior to final acceptance by the owner.

3.9 CLEANING

A. The Contractor shall keep the job site clean, removing all debris and unused material as they occur. At the completion of the work, the Contractor shall thoroughly clean all materials and equipment provided as part of the work.

B. Prior to testing and adjusting, all piping systems, including all components of systems, shall be thoroughly cleaned inside and out.

C. All soil, waste, drain, and rainwater lines shall be rodded out in the presence of the A/E's representative. All cleanout plugs shall be removed, lubricated, and replaced.

D. All piping shall be chemically cleaned prior to final filling and connection to equipment.

E. Painting of the mechanical equipment shall be as specified under other sections of the work. Removing loose scale, rust, drippings, dirt, etc. in preparation for painting shall be done under this section of the specifications.

F. Prior to acceptance of the building, thoroughly clean all exposed portions of the HVAC installation, removing all labels and all traces of foreign substances, using only a cleaning solution approved by the manufacturer of the item being cleaned. Caution should be taken to avoid damage to all finished surfaces.

G. Mechanical Unit shall be protected from dust at all times. Mechanical units shall not be run during construction installation periods that create dust such as sheetrock finishing, cabinetry, or terrazzo, etc. When mechanical units are in operation is approved by the A/E during construction, filters must be in place in the units and over the return air grilles to protect equipment and return air path from construction debris and dust. Filters shall be changed by the contractor as frequently as necessary to ensure the protection of equipment and ductwork. If filters are not in place equipment shall not be operated. Failure of the contractor to comply with these conditions will result in the contractor bearing any and all costs associated with cleaning ductwork and equipment prior to the final acceptance of systems.

3.10 START-UP

A. The Contractor shall place the systems in full operation before testing begins. The Contractor shall make corrections in the system, including furnishing and installing drives, motors, dampers, valves, etc., if required to balance the systems. All such corrections shall be included in the Contractor's base bid and shall be accomplished at no additional cost to the Owner. All piping shall be tested before being covered with insulation or being concealed.

B. All equipment installed under this contract shall be started by a Factory authorized personnel from the manufacturer of the equipment installed.

3.11 DEMONSTRATION AND TRAINING

A. Refer to Division 01 for additional requirements.

B. Location(s):

1. In-Classroom Training: All related information and technical information associated with the equipment and systems, configuration, construction, etc, shall be included.

2. On-site Training: All functions, operational, and maintenance procedures shall be included.

C. Allocate an adequate number of hours for In-Classroom and On-site Training for each piece of equipment or system. The training plan and schedule shall be submitted prior to proceeding.

END OF SECTION 23 0500

SECTION 23 0513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General construction and requirements.

B. Single phase electric motors.

C. Three phase electric motors.

D. Electronically Commutated Motors (ECM).

1.2 RELATED REQUIREMENTS

A. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2026).

C. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.

D. NEMA MG 00001 - Motors and Generators; 2024.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 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.

1.5 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.

1.6 CLOSEOUT SUBMITTALS

A. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

B. Operation Data: Include instructions for safe operating procedures.

C. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

D. Laminated Asset Schedules: documents including, but not limited to, the following:

1. Belt Schedule: Prepare a consolidated belt schedule for each piece of mechanical equipment that requires a belt.
   a. Types of belts required.
   b. Quantity and locations of belts for each equipment.
   c. Frequency of belt changes.

2. Lubrication Schedule: Prepare lubrication charts for each piece of mechanical equipment that requires grease or oil.
   a. Types of lubricants required.
   b. Locations of lubrication points.
   c. Frequency of lubrication.

3. Provide one extra set of belt and lubrication schedule mounted in plastic covers, besides those required in the Operating and Maintenance Manuals, at each mechanical room and/or closet.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture of electric motors with documented experience.

1. For each product specified, provide components by the same manufacturer throughout.

B. Comply with NFPA 70.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.9 WARRANTY

A. Refer to Division 01 and Section 23 0500 requirements.

B. Manufacturer Warranty: Supply manufacturer's standard warranty against defects in product workmanship and materials. Provide five-year manufacturer warranty for motors larger than 10 horsepower. Complete forms in Owner's name and register with the manufacturer.

C. Installer Warranty: Provide one-year warranty for all motors. Complete forms in Owner's name and register with the installer.

D. Warranty periods shall begin from the date of substantial completion .

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Baldor Electric Company/ABB Group; HVAC: www.baldor.com/#sle.

B. Leeson Electric Corporation: www.leeson.com/#sle.

C. Regal-Beloit Corporation (Century): www.centuryelectricmotor.com/#sle.

D. Substitutions: Refer to Division 01 requirements.

2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Comply with Department of Energy efficiency standard for integral horsepower motors, 10CFR Part 431, including Subpart B – Electric Motors and Subpart X – Small Electric motors as distinguished by the motor frame size as defined by NEMA MG 00001.

B. Provide grounding rings installed on all motors that are being used with Variable Frequency Drives. Basis of Design is Aegis

C. Maximum allowable operating speed for variable frequency drives is 60 Hz.

D. Variable Frequency Drives shall be connected to single (only one) motor.

E. All variable frequency drives shall have a line voltage bypass that does not rely on any electronic controls within the drive. All safeties, freezestats etc., shall be in the circuit

F. Comply with IEEE 841 for severe-duty motors.

G. Electrical Service:

1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.

2. Motors Larger than 1/2 Horsepower:208/480 volts, three phase, 60 Hz.

H. Construction:

1. Open drip-proof type except where specifically noted otherwise.

2. Design for continuous operation in 104 degrees F environment.

3. Design for temperature rise in accordance with NEMA MG 00001 limits for insulation class, service factor, and motor enclosure type.

I. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

J. Wiring Terminations:

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.

2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.3 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 104 deg F (40 deg C) and at altitude of 3300 feet (1000 m) 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.

2.4 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

E. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

F. NEMA premium efficiency motors shall be used on all HVAC systems.

2.5 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.

G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

H. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

I. NEMA premium efficiency motors shall be used on all HVAC systems.

2.6 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Comply with NEMA MG 00001 for Design B motors.

E. Insulation System: NEMA Class B or better.

1. Motors used with variable frequency drives shall be listed for such.

F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

I. Service Factor: Comply with IEEE 841, with 1.15 minimum servide factor.

J. Rotor: Random-wound, squirrel cage.

K. Temperature Rise: Match insulation rating.

L. Insulation: Class F.

M. 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.

N. Sound Power Levels: To NEMA MG 00001.

O. Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.

P. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112. NEMA premium efficiency motors shall be used on all HVAC systems.

Q. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

R. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for the controller with the required motor leads. Provide terminals in the motor terminal box, suited to the control method.

S. Motors Used with Variable Frequency Controllers:

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.

2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.

3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with the operation of inverter-duty motors as defined by NEMA MG 00001, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors" for “Usual Service Conditions.”

5. Motors Over 3 HP: Provide with a shaft grounding ring.

2.7 ELECTRONICALLY COMMUTATED MOTORS (ECM)

A. Variable speed, direct current, brushless type motor.

B. Designed for synchronous rotation.

C. Rotor shall be a permanent magnet type with near-zero rotor losses.

D. Provide inductors to minimize harmonic distortion and line noise.

E. Built-in soft start and speed change ramps.

F. Permanently lubricated ball bearings.

G. Minimum 70% efficient over the entire operating range. NEMA premium efficiency motors shall be used on all HVAC systems.

H. Complete with and operated by an integrated speed controller/inverter.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

3.2 IDENTIFICATION

A. Unit information labels and stickers shall never be painted over or covered in any way.

3.3 SCHEDULE

A. Refer to the drawing equipment schedules.

END OF SECTION 23 0513

SECTION 23 0517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe sleeves.

B. Pipe-sleeve seals.

C. Flashing.

1.2 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 23 0719 - HVAC Piping Insulation.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

C. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2024.

D. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.

1.4 CONSTRUCTION SUBMITTALS

A. Refer to Division 1 Requirements.

B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

1.5 QUALITY ASSURANCE

A. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.7 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer Warranty: Supply manufacturer's standard warranty against defects in product workmanship and materials. Provide two-year manufacturer warranty for manufactured sleeves and sleeve seals. Complete forms in Owner's name and register with the manufacturer.

C. Installer Warranty: Provide one-year warranty for manufactured sleeves and sleeve seals commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with the installer.

D. Warranty periods shall begin from Date of Substantial Completion.

E. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PIPE SLEEVES

A. Vertical Piping:

1. Sleeve Length: 1 inch above finished floor and provide floor plate.

2. Provide sealant for watertight joint. Caulk sleeves full depth.

B. Galvanized Sheet Metal: 0.0239 inch minimum thickness pipe passing through interior walls and interior partitions, unless steel or brass sleeves are specified below.

C. Pipe Passing Through Above Grade all Exterior, interior masonry, and interior concrete Walls:

1. Schedule 40 steel pipe ASTM A53/A53M, Type E, Grade B zinc coated with plain ends.

D. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect and structural engineer.

E. Clearances:

1. Provide allowance for insulated piping.

2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter, including insulation.

3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.

2.2 PIPE-SLEEVE SEALS

A. Manufacturers:

1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.

2. American Polywater Corporation; PGKD Modular Seals: www.polywater-haufftechnik.com/#sle.

3. Flexicraft Industries; PipeSeal: www.flexicraft.com/#sle.

4. Substitutions: Refer to Division 01 requirements.

B. Modular Mechanical Sleeve-Seal:

1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.

2. Watertight seal between pipe and wall-sleeve, wall or casing opening.

3. Size and select seal component materials in accordance with service requirements.

4. Glass-reinforced plastic pressure end plates.

C. Sealing Compounds:

1. Provide packing and sealing compound to fill pipe to sleeve thickness.

2. Combined packing and seal compound is to match partition fire-resistance hourly rating.

2.3 FLASHING

A. Flashing for pipes passing through the roof shall be provided as indicated on the drawings or as approved by the Architect.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

3.2 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Structural Considerations:

1. Do not penetrate building structural members unless indicated.

E. Provide sleeves when penetrating floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.

2. Aboveground Piping:
   a. Pack solid using mineral fiber in compliance with ASTM C592.
   b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.

3. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.

F. Manufactured Sleeve-Seal Systems:

1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.

2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.

3. Locate piping in center of sleeve or penetration.

4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.

5. Tighten bolting for a water-tight seal.

6. Install in accordance with manufacturer's recommendations.

G. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.3 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 23 0517

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SECTION 23 0548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

A. Section 23 0529 - Hangers and Supports for HVAC Piping, Ductwork and Equipment.

1.2 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. 29 CFR 1910 - Occupational Safety and Health Standards; Current Edition.

C. 29 CFR 1910.27 - Scaffolds and Rope Descent Systems; Current Edition.

1.3 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.

1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
    a. Manufacturer, type, model number, size.
    b. Height when uncompressed and the static deflection of each isolation element.
    c. Spring constant of each isolation element.
    d. Estimated imposed load on each isolation element.
    e. Spring o. d., free operating and solid heights.
    f. Design of supplementary bases, if any.
    g. Layout of isolator hangers, mounts, and other elements shown on an outline of the isolated equipment, including complete details of attachment to load-bearing structure or supplementary framing
    h. Piping isolators shown and identified on the piping layout drawing.
    i. All concrete foundations and supports (and required reinforcing and forms) will be furnished and installed by another trade. However, this trade shall furnish shop drawings showing adequate concrete

reinforcing steel details and templates for all concrete foundations and supports and all required hanger bolts and other accessories necessary for the proper installation of his equipment. Although another trade will complete all concrete work, all such work shall be shown in detail on the shop drawings, prepared by this trade which drawings shall be submitted showing the complete details of all foundations, including necessary concrete and steel work, vibration isolation devices, etc.

C. Shop Drawings - Vibration Isolation Systems:

1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.

2. Detail fabrication and assembly of equipment bases. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to the structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 CLOSEOUT SUBMITTALS

A. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.5 DESCRIPTION OF SYSTEMS

A. Vibration Isolation

1. Building structure can provide a direct path for mechanically induced vibration to travel from mechanical equipment to noise critical spaces. Rotating or vibrating equipment such as pumps, fans, boiler, chiller, pipes, and ducts shall be mounted on or suspended from vibration isolators to attenuate the vibration transfer from equipment into the building structure.

B. Fan Noise Attenuation

1. Rotating fan blades generate noise, which propagates along duct routes into noise-critical spaces. To control this noise, one or a combination of the following methods is employed:

a. Internal Lining: All duct systems – supply, return, and exhaust – serving critical spaces are internally lined from the fan to the air outlets and inlets or as shown on plans.
b. Duct Silencers: A silencer is a prefabricated unit that is inserted into a duct run to reduce duct-borne noise. Laboratory testing certifies the insertion loss, pressure drop, and regenerated noise of the silencer.

2. Foam Rod is used to seal around duct penetrations as they pass through block work or concrete.

3. Non-Hardening Sealant is used to seal the Foam Rod to the ducts and to the construction through which the ducts penetrate.

C. Sealing of Penetrations

1. Building structures meant to isolate air-borne noise surround noise critical spaces and spaces that contain noise, i.e. mechanical equipment rooms. These building structures must be massive, airtight constructions. The effectiveness of sound isolating structures can be compromised by penetrations for ductwork and piping. Proper sealing and/or lagging (enclosure) around mechanical services penetrating these structures will maintain the integrity of the isolating structure.

1.6 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with documented experience.

1. For each product specified, provide components by the same manufacturer throughout.

C. Testing Agency Qualifications: Independent agency or firm specializing in performing testing and inspections of the type specified in this section that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

D. Contractors Responsibility:

1. The installation of all noise and vibration control systems shall be under the supervision of the manufacturer's representative or approved installer.

2. The Contractor shall be responsible for verifying the completeness of the isolation installation and the overall suitability of the equipment to meet the intent of this specification. The Contractor, even if not specifically mentioned herein or in the Contract Documents, shall supply any additional equipment needed to meet the intent of this specification, without claim for additional payment.

3. Performance or waiving of inspection, testing or surveillance for any portion of the Work shall not relieve the Contractor of the responsibility to conform strictly to the Contract Documents. The Contractor shall not construe performance or waiving of inspection, testing or surveillance by the Owner or Architects to relieve the Contractor from total responsibility to perform in strict accordance with the Contract Documents.

4. The intent of the designers is that there are no conflicts between this and other sections of the specification. If conflicts are discovered between this section and any other section or subsection, it shall be the contractor’s responsibility to immediately bring this opinion to the architect’s attention and to request instruction. Absent that instruction, the contractor shall assume that this current section shall overrule in any conflicts.

E. Manufacturers Responsibilities: The equipment Manufacturer of vibration isolation equipment shall have the following responsibilities

1. A single manufacturer shall provide all vibration isolation equipment and materials. The following manufacturers are approved, provided systems are in compliance with the specified design and performance requirements. The project acoustics consultant must approve any others.

2. Provide piping and equipment isolation systems as scheduled or specified.

3. Guarantee specified isolation system deflection.

4. Provide installation instructions, drawings and field supervision to assure proper installation and performance.

5. The vibration isolation systems shall be guaranteed to have deflection indicated on the schedule on the drawings. The mounting manufacturer shall determine mounting sizes and the sizes shall be installed in accordance with the manufacturer's instructions.

6. The vibration isolator vendor shall ensure that all equipment to be isolated has sufficient support structure to distribute equipment loads onto isolators. Where additional support structure is required, vibration isolator vendor shall provide this.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

1.8 WARRANTY

A. Refer to Division 01 for additional warranty requirements.

B. Manufacturer Warranty: Supply the manufacturer's standard warranty against defects in product workmanship and materials. Provide one-year manufacturer warranty for all vibration. Complete forms in the Owner's name and register with the manufacturer.

C. Installer Warranty: Provide one-year warranty for vibration commencing on the Date of Substantial Completion. Complete forms in the Owner's name and register with the installer.

D. Warranty periods shall begin from the Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment provided for vibration isolation or noise control shall be new and manufactured specifically for the purpose intended.

B. All vibration isolators, base frames, and inertia bases must conform to all uniform deflection and stability requirements under all operating loads.

C. Steel springs to function without undue stress or overloading.

D. All equipment mounted on vibration-isolated bases to have a minimum operating clearance of 2 inches (50 mm) between the base and the floor or support beneath, unless noted otherwise.

E. The vibration isolator supplier shall determine vibration isolator sizes and layout.

F. All vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment, verified, thus determining that the load is within

the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.

G. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than ±10%.

H. All neoprene mountings shall have a Shore hardness of 30 to 60 ±5, or as specified herein, after minimum aging of 20 days or corresponding over-aging.

I. Housed or caged spring isolators are not acceptable.

J. Where steel spring isolation systems are described in the specifications, the mounting assemblies shall utilize bare springs with the spring diameter not less than 0.8 of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the spring remain parallel during and after the spring installation. All isolators shall operate in the linear portion of their load versus deflection curve and have 50% excess capacity without becoming coil-bound.

K. All mounting systems exposed to weather and other corrosive environments shall be protected with factory corrosion resistance. All metal parts of mountings (except springs and hardware) shall be hot-dip galvanized. Springs shall be cadmium plated and neoprene coated. Nuts and bolts shall be cadmium plated.

2.2 VIBRATION ISOLATORS

A. Manufacturers:

1. Vibration Isolators:
   a. Amber/Booth Company, Inc.
   b. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle. Dublin, Ohio
   c. Mason Industries: www.mason-ind.com/#sle. Hauppauge, New York
   d. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
   e. Vibration Mountings and Controls, New Hyde Park, NY.

2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:

1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.

2. Spring Elements for Spring Isolators:

a. Color code or otherwise identify springs to indicate load capacity.
b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
f. Selected to function without undue stress or overloading.

C. Vibration Isolators for Nonseismic Applications:

1. Resilient Material Isolator Pads: RBA

2. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.

3. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.

4. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.

5. Type RBA: Mason Industries Type RBA or as approved

6. Type RBA isolators shall be designed with a neoprene element to provide isolation in tension, shear, or compression. Neoprene to bridge bearing quality with a maximum durometer of 50.

7. Isolator Type: Waffle Pads (WP)
   a. Manufacturers:
      1) Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle. Dublin, Ohio
      2) Mason Industries; W: www.mason-ind.com/#sle. Hauppauge, New York
      3) Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
      4) Vibro-Acoustics;: www.vibro-acoustics.com/#sle.
      5) Vibration Mountings and Controls: New Hyde Park, NY.
   b. Construction: 5/16 inch thick neoprene pads ribbed or waffled on both sides. The pads shall be manufactured with bridge bearing quality neoprene and selected for a maximum durometer of 50 and designed

for 15% strain. Where required, steel load spreading plates shall be incorporated between the equipment and the neoprene pad.

c. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.

8. Isolator Type: Metal and Waffle Sandwich Pads (MWP)
   a. Manufacturers
      1) Kinetics Noise Control, Inc;: www.kineticsnoise.com/#sle. Dublin, Ohio
      2) Mason Industries; WSW: www.mason-ind.com/#sle. Hauppauge, New York
      3) Vibration Eliminator Company, Inc;: www.veco-nyc.com/#sle.
      4) Vibro-Acoustics;: www.vibro-acoustics.com/#sle.
      5) Vibration Mountings and Controls: New Hyde Park, NY.
   b. Construction: consist of two 5/16 inch thick ribbed or waffle neoprene pads sandwiching a 16 gauge stainless steel shim plate. The pad shall be manufactured with bridge-bearing quality neoprene and selected for a maximum durometer of 50 and designed for 15% strain.
   c. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660, or as approved) shall be installed under the bolt head between the steel washer and the base plate.

9. Isolator Type: Single Deflection Neoprene Mounts (SDNM)

10. Isolator Type: Double Deflection Neoprene Mounts (DDNM)
    a. Manufacturers:
       1) Kinetics Noise Control, Inc;: www.kineticsnoise.com/#sle. Dublin, Ohio
       2) Mason Industries; ND: www.mason-ind.com/#sle. Hauppauge, New York
       3) Vibration Eliminator Company, Inc;: www.veco-nyc.com/#sle.
       4) Vibro-Acoustics;: www.vibro-acoustics.com/#sle.
       5) Vibration Mountings and Controls; RD: New Hyde Park, NY.
    b. shall be laterally stable, double deflecting, molded neoprene isolators. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed and bolt holes shall be provided in the base. The mounts shall have leveling bolts rigidly secured to the equipment.

c. The isolator shall be manufactured with bridge bearing quality neoprene and selected for a maximum durometer of 50 and designed for 15% strain. DDNM mounts shall be selected for a static deflection of 3/8 inch unless otherwise specified.

11. Products:
    a. Type WP: Mason Industries Type W or as approved.
    b. Type MWP: Mason Industries Type WSW or as approved.
    c. Type NM: Mason Industries Type ADA or as approved.
    d. Type DDNM: Mason Industries Type ND or as approved.

12. Open (Unhoused) Spring Isolators:
    a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
    b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
    c. Furnished with integral leveling device for positioning and securing supported equipment.
    d. Isolator Type: Spring and Neoprene Mounts (SPNM)
        1) shall have a free-standing and laterally stable steel spring without any housing. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall be not less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection.
        2) Unless otherwise specified, the minimum static deflection of SPNM isolators for equipment mounted on grade slabs shall be 1 inch and the minimum static deflection for equipment mounted above grade level shall be 2 inches.
        3) Two Type WP isolation pads sandwiching a 16 gauge stainless or galvanized steel separator plate shall be bonded to the isolator baseplate.
        4) Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If the base plates are bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.

13. Housed Spring Isolators:
    a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
    b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
    c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
    d. Furnished with integral leveling device for positioning and securing supported equipment.
    e. Isolator Type: Constrained Spring and Neoprene Mounts (CSNM)
        1) shall be a spring and neoprene mount that incorporates a housing which incorporates unrestrained stable springs with built-in leveling device and resilient vertical limit stops to prevent spring elongation when partial load is removed and limits the movement of equipment when it is subjected to wind loading.
        2) A minimum clearance of 1 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring operation. Limit stops shall provide minimum 1/4” clearance under normal operation and a neoprene washer shall be installed beneath the bolt head/ washer used to restrain the isolator.
        3) In installations subject to wind load, provide a tapped hole in top and bottom plates for bolting to equipment and the roof or supporting structure with a neoprene mounting sleeve.
        4) Provide minimum 1/4” inch thick neoprene acoustical base pad on the underside of mount unless designated otherwise.
        5) Mount shall be capable of supporting equipment at a fixed elevation during equipment erection. Installed and operating heights shall be identical.
        6) Unless otherwise specified, the minimum static deflection for Type CSNM mounts shall be 2 inches.
        7) Spring diameter and hanger box hole size shall be large enough to permit the hanger rod to swing through a 30 degree arc. A neoprene sleeve or grommet shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole

in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked and the hanger box shall be allowed to rotate through a full 360 degree arc without encountering any obstructions. When installed and loaded, if the threaded rod touches the neoprene at the bottom of the hanger box, instructions shall be given to make an adjustment.

14. Resilient Material Isolator Hangers, Nonseismic: Double Deflection Neoprene Hangers (DDNH)
    a. Manufacturers:
        1) Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle. Dublin, Ohio
        2) Mason Industries; HD: www.mason-ind.com/#sle. Hauppauge, New York
        3) Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
        4) Vibration Mountings and Controls: New Hyde Park, NY.
        5) Vibro-Acoustics: www.vibro-acoustics.com/#sle.
    b. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection.
    c. Construction: shall consist of a molded neoprene isolating element in a steel hanger box. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30 degree arc. When installed, the hanger box shall be allowed to rotate through a full 360 degrees without encountering any obstructions.
    d. Deflection: The isolator shall be manufactured with bridge-bearing quality neoprene and selected for a maximum durometer of 50 and designed for 15% strain. Unless otherwise specified, the static deflection of DDNH hangers shall be 0.3 inches.

15. Spring Isolator Hangers, Nonseismic: Spring Hangers (SPH)
    a. Manufacturer:
        1) Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle. Dublin, Ohio
        2) Mason Industries: www.mason-ind.com/#sle. Hauppauge, New York

3) Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
4) Vibro-Acoustics: www.vibro-acoustics.com/#sle.
5) Vibration Mountings and Controls: New Hyde Park, NY.

b. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric neoprene isolating element for the lower hanger rod connection.
c. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
d. Static Deflection: 2 inches. The spring shall have a minimum additional travel to solid equal to 50% of the specified deflection.

16. Combination Resilient Material/Spring Isolator Hangers, Nonseismic: Spring and Neoprene Hangers (SPNH)
    a. Manufacturer:
        1) Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle. Dublin, Ohio
        2) Mason Industries; 30N: www.mason-ind.com/#sle. Hauppauge, New York
        3) Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
        4) Vibration Mountings and Controls; RHD: New Hyde Park, NY.
        5) Vibro-Acoustics: www.vibro-acoustics.com/#sle.
    b. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper and lower hanger rod connection.
    c. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
    d. Static Deflection: 2 inches. The spring shall have a minimum additional travel to solid equal to 50% of the specified deflection. The neoprene element shall have a static deflection of not less than 0.3 inches with a strain not exceeding 15%.
    e. A neoprene sleeve or grommet shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked and the hanger box shall be allowed to rotate through a full 360 degree arc

without encountering any obstructions. When installed and loaded, if the threaded rod touches the neoprene at the bottom of the hanger box, instructions shall be given to make an adjustment.

17. Thrust Restraints:
    a. Description: Assembly utilizing free-standing, laterally stable steel spring designed for resisting horizontal motion due to thrust (e.g., air pressure from a fan), and intended for installation in pairs.

18. Neoprene Pad Isolators:
    a. Products
        1) Type NP: Mason Industries Type HL or as approved
    b. Hardness: 30 durometer.
    c. Thickness: Minimum 1/2 inch.
    d. Maximum Loading: 50 psi.
    e. Rib Height: Maximum 0.7 times width.

2.3 NEOPRENE MOUNTING SLEEVES

A. Neoprene mounting sleeves for hold-down applications of equipment with vibration isolators shall be Uniroyal Type 620/660 or as approved.

2.4 FOAM ROD

A. Foam backer rod shall be closed-cell polyethylene suitable for use as a backing for non-hardening sealant.

2.5 NON-HARDENING SEALANT

A. Sealant for penetrations shall be a non-hardening polysulphide type.

B. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise-critical walls that are also fire-rated.

2.6 PACKING MATERIAL FOR PENETRATIONS

A. Mineral fiber; non-combustible; resistant to water, mildew, and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 pcf (40 kg/m3).

2.7 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.

2. All hardware shall be galvanized. Hot-dip-galvanize metal components for exterior use.

3. Bake enamel or powder coat for metal components on isolators for interior use.

4. Color-code or otherwise mark vibration isolation and wind control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. All equipment, piping, etc., shall be mounted on or suspended from approved foundations and supports, all as specified herein, or as shown on the drawings.

B. All floor-mounted equipment shall be erected on 4" thick concrete housekeeping pads over the complete floor area of the equipment, unless otherwise specified to the contrary herein. These pads shall be integrally keyed tothe structural slab. Wherever vibration eliminating devices are specified, these items shall, in all cases, be in turn mounted on concrete housekeeping pads unless otherwise specified to the contrary herein.

C. Furnish and install neoprene mounting sleeves for hold down bolts to prevent any metal to metal contact.

D. All equipment shall be provided with lateral restraining isolators as required to limit horizontal motion to 1/4" maximum, under all operating conditions. Lateral restraining isolators shall have the same having the same static deflection as the equipment being isolated.

E. Unless otherwise indicated, all equipment mounted on vibration isolators shall have a minimum operating clearance of 2 inches between the bottom of the equipment (and height saving bracket) and the concrete housekeeping pad (bolt heads)

beneath the equipment. The clearance shall be checked by the Contractor to ensure that no material has been left to short circuit the vibration isolators. There shall be a minimum 4 inch clearance between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.

F. Piping, ductwork, conduit, or mechanical equipment shall be supported fromthe building structure, not hung from or supported on other equipment, pipes, or ductwork.

G. Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping and blocked up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims.

H. All mechanical equipment not specifically identified in this specification that contains rotating or vibrating elements and any associated electrical apparatus installed by this division that contains transformers or inductors shall be installed on Type DDNM or RBA neoprene isolators as appropriate.

I. All wiring connections to mechanical equipment on isolators shall be made with a minimum 36 inch long flexible conduit in a 180 degree “U” shaped loop.

J. Elastomeric isolators that will be exposed to temperatures below 32 degrees F shall be fabricated from natural rubber instead of neoprene.

K. Springs shall be designed and installed so that ends of the springs remain parallel, and all springs installed with adjustment bolts.

L. Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.

M. Install products in accordance with manufacturer's instructions.

N. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

O. Secure fasteners according to manufacturer's recommended torque settings.

P. Piping Support

1. All piping shall be resiliently supported:
    a. All piping on all systems on the project in mechanical rooms, outside mechanical rooms, in chases, everywhere throughout the building.

b. All piping where exposed on roof.

Q. Hanger rod isolators for steam and condensate piping, including steam pressure reducing valve stations, shall be supported by means of neoprene-in-shear mountings providing a minimum static deflection of 1/2".

1. Resilient diagonal mountings or other approved devices shall be provided as required to limit piping motion due to equipment startup or shutdown, to a maximum of 1/8".

2. Fluid piping hanger rod isolators shall contain a 2” static deflection steel spring in series with a double-deflection neoprene element within a steel box retainer. The hanger rod isolator assembly shall be rigidly supported from he spring sub-assembly shall not contact the steel box retainer, and clearances in the isolator design shall be capable of accepting a 15 degree misalignment in any direction from the vertical.

3. The steel spring element of the assembly shall be designed to have a minimum surge frequency of 340 HZ and a minimum deflection of 3/4".

4. Hanger rod isolators for steam and condensate piping, including steam pressure reducing valve station,s shall be supported by means of neoprene-in-shear mountings providing a minimum static deflection of 1/2".

5. Where supplementary steel is required to support piping, the supplementary steel shall be sized so that maximum deflection between supports does not exceed 0.08" and shall be resiliently supported from the building structure with mountings as described above. Supported piping from the supplementary steel shall be rigidly suspended or supported.

6. Precompressed type hanger rod isolators shall be provided for all water piping greater than 12" diameter and all supplementary steel supports. The precompression shall be factory set at 75% of rated deflection.

7. Where isolated water piping 8" and larger is supported directly below exposed steel beams, attachment to the beam shall be made by means of welded channel beam attachments located directly under the web of the beam. For piping 6" and smaller, beam clamps may be used in lieu of welding, subject to approval of beam clamp selection.

R. Anchors

1. The pipe riser clamp at anchor points shall be welded to the pipe and to pairs of vertical acoustical pipe anchor mountings which in turn, shall be rigidly fastened to steel framing in the pipe shaft.

S. Vertical Pipes and Risers Supports

1. Piping supports within shafts shall be provided with suitable bearing plates and two layers 1/4" thick ribbed or waffled neoprene pad loaded for 50 psi maximum. The isolation pads shall be separated with 1/4" steel plate.

2. Piping isolation supports at the base of risers shall be two layers of 1/2" thick heavy-duty neoprene and canvas duct isolation pad separated by 1/4" thick steel plate. Suitable bearing plates sized to provide a pad loading of 500 psi maximum shall be provided. The stanchion between the pipe and isolation support shall be welded to the pipe and welded or bolted to the isolation support. The isolation support shall be bolted to the floor slab with resilient sleeves and washers.

3. All pipe support resilient materials shall be a neoprene pad.

4. Where pipes rise in a vertical chase and are supported from a structure with type SPNH or DDNH isolators and require lateral bracing, neoprene riser guides shall be mounted around the pipe to limit lateral movement and to prevent direct contact with the supporting structure.

T. Pipes Connected to Equipment on Spring Isolators

1. All pipes connected to equipment installed on spring vibration isolators shall be suspended or, supported by Typ SPNM or SPNH isolators. Provide vibration isolation anchors and guides as specified elsewhere in this specification.

2. The first isolator, both upstream and downstream of the equipment, on springs, shall have a static deflection equal to 1.5 times that of the equipment isolators, up to a maximum of 2 inches. The static deflection of the remaining pipe isolators shall be 1 inch.

3. If pipes are supported on a noise-critical structure, the 1.5 times spring deflection rule above applies throughout the pipe run.

U. Pipes Connected to Equipment on Neoprene Isolators

1. Piping that is connected only to machinery installed on neoprene isolators shall be either supported from the floor on Type DDNM mounts or suspended from the structure on Type DDNH hangers.

V. Pipes with Multiple Connections

1. Where a pipe run connects multiple items of equipment in the mechanical room the pipe isolators for the entire run shall be chosen to suit the connected equipment of greatest static deflection.

W. Pipe Penetrations

1. Where a pipe passes through a noise-critical wall, ceiling, or floor slab, a steel sleeve shall be cast or grouted into the structure. The internal diameter of the sleeve shall be 2 inches larger than the external diameter of the pipe passing through it. After all of the piping is installed in that area, the Contractor shall check the clearance and correct it, if necessary, to within 1/2 inch. Then the void shall be packed full depth with glass /mineral fiber and sealed at both ends, 1 inch deep, with sealant backed by foam rod.

X. Duct Supports

1. Ducts in mechanical rooms and locations where mechanical equipment may be mounted outside mechanical rooms shall be supported by open spring with neoprene cups on both ends hangers, Type SPNH.

2. Ducts within 25 feet from the mechanical room and equipment weighing less than 20 lbs shall be supported by neoprene hangers, Type DDNH.

3. Ducts beyond 25 feet from the mechanical room shall be supported by conventional threaded rods and unistrut methods.

Y. Duct Isolation

1. Ducts shall be connected to fans and fan casings by means of flexible connectors. Flexible connectors shall be installed to prevent metal-to-metal contact across the flexible connection. Flexible duct connectors shall not be used outside the mechanical room unless expressly shown on the drawings.

Z. Ductwork Bracing

1. Do not install tie rods within ducts serving noise-critical spaces.

AA. Acoustical Lining of Ducts

1. Ducts shall be acoustically lined internally, from the air moving device to the terminal. supply, return, and exhaust air systems shall be internally lined where noted on the drawings unless otherwise specified to reduce sound transmission.

2. Other ductwork shall be acoustically lined where shown on the drawings.

3. Acoustical duct lining shall be 2 inches thick in ducts within ME Rooms, in risers serving noise-critical spaces, and where shown on the drawings. Acoustical duct lining shall be 2-inch thick in all other internally lined sheet metal ducts, unless otherwise specified or shown on the drawings.

4. The acoustical liner shall be fixed to the duct with a minimum of 50% coverage of a fire-resistant adhesive. Where the duct width exceeds 12 inches or the height 24 inches, the liner shall be additionally secured with mechanical fastening on maximum 16 inch centers on all sides. Mechanical fasteners that pierce the duct are unacceptable. All ends of the liner shall be coated with a fire-resistant cementing material to prevent delamination, leakage or erosion. All joints shall be firmly butted and ends coated with an adhesive to ensure that the lining is smooth across all joints.

5. Where acoustical duct lining is installed, the dimensions of the sheet metal shall be increased to include the thickness of the lining material. Dimensions shown on the mechanical drawings are the clear internal dimensions after the liner has been installed.

BB. Duct Penetrations

1. Where each duct passes through a noise critical wall, floor or ceiling surrounding any noise critical spaces, there shall be a clear annular space of 1 inch between the duct and structure. After all of the ductwork is installed the Contractor shall check the clearance, pack the voids full depth with mineral fiber batt insulation and caulk both ends with a non aging, non hardening sealant backed by a polyethylene foam rod or permanently flexible firestop material.

2. Where there is not sufficient access space to pack around all sides of a duct (for example, at the underside of a slab), place a short stub duct in the wall, pack and caulk around it, and then attach the inlet and outlet ducts to each end.

CC. General Fan Isolation

1. fans and equipment with fans shall be leveled with the fans operating before the flexible connectors are attached.

2. All fan bases and isolators shall be sized so that thrust restraints (which would act against turning moment caused by static pressure) are not required.

DD. Suspended Fans

1. Fans suspended from overhead structure shall be hung on Type SPNH spring isolators. Unless otherwise specified in the Schedule, the static deflection of the isolators shall be 2 inches. Fans shall be suspended from above only if expressly noted as such on the drawings and schedules. Thrust restraint shall be by pre compressed isolators.

EE. Dust Collection System

1. Each such fan and driving motor shall be mounted on an integral one-piece structural base, reinforced as necessary to prevent flexure of the base at start-up and during operation of the fan.

2. The unitized structural base for the fan and motor shall include motor slide rails. The structural steel frame shall be drilled and tapped to receive the fan and motor so that the frame shall act as a template.

3. The structural steel integral base shall be supported on neoprene in shear mountings. These mountings shall be positioned in accordance with the weight distribution to ensure adequate deflection and vibration isolation. Caged or Housed devices shall not be used to contain the isolation springs.

FF. Controls

1. Self-timers for mechanical systems shall not be located in noise critical spaces.

GG. Wiring

1. All wiring connections to mechanical equipment on vibration isolators (either spring or neoprene type) shall be made with a minimum 36 inch (1m) long flexible conduit in a 180 degree “U” shaped loop. This Contractor shall coordinate wiring connections with the Electrical Contractor.

3.3 FIELD QUALITY CONTROL

A. Inspect vibration isolation and/or seismic control components for damage and defects.

B. Contractor shall work in accordance with best trade practices, shall fabricate and install all items in accordance with the manufacturer's recommendations and the Architect's directions, and shall consult with trades doing adjoining work in order to provide an installation of first class quality.

C. Site Access

1. During the installation of equipment, Contractor shall arrange for access as necessary for inspection of isolation and noise control equipment by Architect and his representatives.

D. Contractor's Report

1. The vibration isolation vendor shall inspect and approve the installation of the vibration isolators and shall submit a report to the Owner, which verifies that all of the isolation equipment has been properly installed and that the installation is in full conformance with the specification. The report shall record the vibration isolator identification and model or type. For isolators containing steel springs, the report shall also record the size and uncompressed height, design static deflectio,n and measured static deflection of the isolators provided.

E. Consultant's Inspection

1. Upon completing installation and adjustment for suitable operation of all work specified under this section, the Contractor shall notify the Architect in writing. The letter shall certify that all work specified under this section is complete, operational, and adjusted in every respect, and that all work is ready for the completion checkout. A copy of the air balancing report and the vibration isolation report shall accompany the notification letter.

2. For each inspection, Contractor shall perform such functions as are necessary for inspection of the equipment. Background noise level testing must be carried out during late-night hours when ambient noise from outside is at a minimum and the site is otherwise not occupied and no work is underway. Contractor shall turn on and off any and all mechanical equipment during such background noise level testing.

F. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 ADJUSTING

A. Adjust isolators after the piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust the active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within the normal mode of operation.

3.5 SCHEDULE

A. Refer to the drawings.

VIBRATION ISOLATION SCHEDULE FOR MECHANICAL EQUIPMENT			
EQUIPMENT TYPE	BASE TYPE	ISOLATOR TYPE	STATIC DEFLECTION
Pipes Connected to Equipment on Neoprene Isolators		DDNH	1"
Pipes Connected to Equipment on Spring Isolators		SPNH	2"
All Other Pipe Supports (Inside mech room)		NM	3/8"
All Other Pipe Supports (Outside mech room)		N / A	-
Pipe Isolation to Equipment		Flexible Connector	-
Pipes Anchors		NH or NM	3/8"
Pipe Risers		NM	3/8"

Structure Suspended Ducts Connected to Equipment on Spring Isolators		DDNH	1"
Structure Suspended Ducts Connected to Equipment on Neoprene Isolators		SPNH	2"
All Other Duct Supports (Inside mech rooms)		NH	3/8"
All Other Duct Supports (outside mech rooms)		N / A	
Duct Isolation to Equipment		Canvas Flex Duct	-
Roof Mounted Outdoor Air Units (OAU) and Rooftop Units (RTU)	MFR Curb	Internal SPNM External MWP	1"
Roof Mounted Cooling Tower	Structural Rails as Required	Internal SPNM External MWP	
Roof Mounted Exhaust Fans	MFR Curb		
Roof Mounted Heat Pumps or Condensing Units	Structural Rails as Required		
Structure-Mounted Fans		SPNH	1"
Fan Powered Air Terminal Units		SPNH	1"
Shut-off w/ Sound Attenuation Air Terminal Units		DDNH	3/8"
Shut-off w/o Sound		-	-

Attenuation Air Terminal Units			
Structure-Mounted Unit Heaters		SPNH	1"
Suspended or ceiling-mounted air handlers		SPNH	1"
Suspended or ceiling-mounted Water Source Heat Pumps		SPNH	1"
Suspended or ceiling-mounted fan coil units		SPNH	1"
Suspended or ceiling-mounted VRF Indoor units		SPNH	1"
Wall-mounted Propeller fans		SPNM	3/8"
Floor-Mounted AHU, OAU, ERU, and BCU	4” Concrete housekeeping pad	Internal SPNM External MWP	3/8"
Floor-mounted Split System Air Handler	4” Concrete housekeeping pad	External MWP	3/8"
Floor-mounted Water source heat pumps	4” Concrete housekeeping pad	External MWP	
Floor-mounted fan coil units	4” Concrete housekeeping pad	External MWP	
Base-mounted pumps (1 HP or greater)	Inertia Base w/ 4" Housekeeping Pad	SPNM	2"
Base-mounted pumps (less than 1 HP)	4” Concrete housekeeping pad	SPNM	1"
Floor Mounted Hydronic Specialties without pumps or motors (ET and CT)	4” Concrete housekeeping pad	MWP	3/8"

Floor Mounted Boiler	4” Concrete housekeeping pad	MWP	3/8"
Floor Mounted Chiller	4” Concrete housekeeping pad	MWP	1"
On-Grade Chiller	4” Exposed Concrete	MWP	1"
On-Grade Cooling Tower	4” Exposed Concrete pad w/ steel frame	Indoor SPNM External SPNM	1"
On-Grade Heat Pumps or Condensing Units	4” Exposed Concrete	MWP	3/8"
On-Grade Dust Collector	4” Exposed Concrete	WP	3/8"

END OF SECTION 23 0548

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SECTION 23 0553 - IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Labels.

C. Tags.

D. Adhesive-backed duct markers.

E. Stencils.

F. Pipe markers.

G. Ceiling nameplates.

1.2 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting: Identification painting.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

C. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2025.

1.4 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, type of service, normal position, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

B. Project Record Documents: Record actual locations of tagged valves.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1. For each product specified, provide components by the same manufacturer throughout.

2. The manufacturing company shall have local representation to provide continuing support for each identification and engraved nameplate product.

3. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.7 COORDINATION

A. Coordinate the installation of identifying devices with the completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate the installation of identifying devices with the location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on-site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in its original wrapping.

C. Do not install wet or water-damaged materials.

1.9 WARRANTY

A. Refer to Division 01 requirements.

B. Manufacturer Warranty: Supply the manufacturer's standard warranty against defects in product workmanship and materials. Provide one-year manufacturer warranty for nameplates, tags, and other idenitification devices.

C. Installer Warranty: Provide one-year warranty for HVAC identification commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with the installer.

D. Special Warranty: Provide two-year warranty for HVAC identification commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with warrantor.

E. Warranty periods shall begin from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Automatic Controls: Tags. Key to equipment served.

C. Control Panels: Nameplates.

D. Dampers: Tags for equipment, ceiling nameplates, where located above lay-in ceiling.

E. Interior, flexible external insulation Ductwork: Stencilled painting.

F. Instrumentation: Tags.

G. Major Control Components: Nameplates.

H. Piping: As noted below.

1. Concealed in finished spaces and Exposed in unfinished spaces: Pipe markers.

2. Exposed in unfinished spaces and Large diameter: Tags

I. Relays: Label.

J. Small-sized Equipment: Nameplates and ceiling nameplates located above lay-in ceiling.

K. Thermostats, Humidistats, and Sensors: Labels.

2.2 NAMEPLATES

A. Manufacturers:

1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com/#sle.

2. Brimar Industries, Inc; Briply: www.pipemarker.com/#sle.

3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.

4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.

5. Seton Identification Products, a Tricor Direct Company; Setonflex: www.seton.com/#sle.

6. Substitutions: Refer to Division 01 requirements.

B. Description: Laminated three-layer plastic with engraved letters.

C. Letter Color: White.

D. Maximum Letter Height: 3/4 inch for all equipment identification.

E. Minimum Letter Height: 1/4 inch for all control panels and small items of equipment.

F. Background Color: Black.

G. Minimum Letter Size: 1/4 inch for name of units if the viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

H. Label Content:

1. Principal lettering: Include the equipment's unique equipment number/mark.

2. Secondary lettering: Specification section number where equipment is specified.
   a. Electrical panel and circuit serving unit located on the disconnect.

2.3 LABELS

A. Manufacturers:

1. Printer.

2. Handheld device.

B. Description: Laminated layered paper with printed letters.

C. Letter Color: Black.

D. Minimum Letter Height: 1/4 inch for all control panels and small items of equipment.

E. Background Color: White.

F. Label Content:

1. Principal lettering: Include the equipment's unique equipment number/mark.

2. Secondary lettering: Mechanical equipment served.
   a. Electrical panel and circuit serving unit located near the disconnect.

2.4 TAGS

A. Manufacturers:

1. Seton Identification Products, a Tricor Company; 250 BL: www.seton.com/#sle.

2. Substitutions: Refer to Division 01 requirements.

B. Metal Tags: Brass with stamped with black filled 1/2" letters and numbers; tag size minimum 1-1/2 inch diameter with smooth edges.

C. Fasteners: Brass "S" hook chain.

D. Tag Chart: Typewritten letter size list in 1/8" thick clear plastic, anodized aluminum frame.

E. Tag Mark: Valve tags shall begin with number one and be numbered consecutively. Provide schedule with location and system, area, or equipment served.

2.5 ADHESIVE-BACKED DUCT MARKERS

A. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch; printed with UV and chemical resistant inks.

B. Style: Individual Label.

C. Color: Comply with ASME A13.1.

2.6 STENCILS

A. Stencils: With clean cut symbols and letters of following size:

1. Ductwork 10" in height or smaller: 2-1/2 inch high letters.

2. Ductwork 12" in height or larger: 3-1/2 inch high letters.

3. Outdoor equipment, roof fans, condensing units and heat pumps shall be labeled with stenciled letters 1.5” high.

B. Stencil Paint: As specified in Division 09, semi-gloss enamel, colors complying with ASME A13.1.

C. Painted with contrasting colored enamel paint to the applied surface.

2.7 PIPE MARKERS

A. Manufacturers:

1. Craftmark Pipe Markers: www.craftmarkid.com/#sle.

2. Seton Identification Products, a Tricor Company; Opti-Code: www.seton.com/#sle.

3. Wilmington Plastics Co.

4. Substitutions: Refer to Division 01 requirements.

B. Color: Comply with ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings with flow arrows.

1. Manufacturers:
   a. Seton Identification Products, a Tricor Company; #AR: www.seton.com/#sle.
   b. Approved Equals.
   c. Substitutions: Refer to Division 01 requirements.

2.8 PIPE TAGS

A. Manufacturers:

1. Seton Identification Products, a Tricor Company: www.seton.com/#sle.

B. Plastic Pipe Markers: Factory fabricated, flexible, pretensioed semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Color: Comply with ASME A13.1.

D. Fasteners: fastened around the pipe with straps.

2.9 CEILING NAMEPLATES

A. Manufacturers:

1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com/#sle.

2. Brimar Industries, Inc; Briply: www.pipemarker.com/#sle.

3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.

4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.

5. Seton Identification Products, a Tricor Direct Company; Setonflex: www.seton.com/#sle.

6. Substitutions: See Division 01 requirements.

B. Description: Laminated three-layer plastic with engraved letters.

1. Letter Color: Black.

2. Letter Height: 1/4 inch. Coordinate with grid width.

3. Background Color: White.

4. Plastic: Comply with ASTM D709.

5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

6. Label Content:
   a. Principal lettering: Include the equipment's unique equipment number/mark.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09 9123 for stencil painting.

3.2 INSTALLATION

A. Unit information labels and stickers shall never be painted over or covered in any way.

B. Nameplates:

1. Install nameplates with corrosive-resistant mechanical screw fasteners.

2. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

3. Nameplates shall align with each other and shall be square with lines of surface on which the label is placed.

4. Do not provide exposed external nameplates for equipment located in the finished space. Conceal nameplates inside devices, and/or access panels.

5. Identify air handling units, heat transfer equipment, fans, and heaters with plastic nameplates.

6. Small devices, such as dampers, shall be identified with tags.

7. Labels shall be installed that identify which equipment pair and system operate together as one system.

8. Provide power source labeling.

9. Identify control panels and major control components outside panels with plastic nameplates.

10. Refer to individual equipment sections for additional information.

C. Labels:

1. Identify control components with printed labels with the system served or equipment served in a non-visible location.

2. For thermostats, humidistats, and other sensors located in finished spaces labels shall be included on the inside surface of the enclosure, casing, and panels.

3. Identify all switches, gauges, disconnects, panels, and pilot lights with labels.

D. Tags:

1. Install tags with corrosion-resistant chain in a visible location.

2. Identify valves in main and branch piping with tags.

3. Small devices, such as airflow monitoring stations and dampers, shall be identified with tags.

4. Identify unit heaters and other equipment's actuators, control valves, and other valves with numbered tags.

E. Apply stencil painting in accordance with Division 09.

1. Duct stencils are to be applied to ducts with exterior flexible insulation.

F. Pipe Markers:

1. Install plastic pipe markers in accordance with manufacturer's instructions.

2. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

3. All markers shall be held in place with color-coded tape with flow direction arrows printed on it. Apply a minimum of three (3) complete wraps of tape at each end of pipe markers.

4. Color coded tape pipe markers with flow arrows shall be applied within 12” of each pipe hanger.

5. Additional markers shall be applied as required to permit reasonable visual identification of each visible pipe line from access doors, shaft openings, removable ceiling panels and other inspection areas.

6. Pipe markers with system name and color coded tape flow arrows shall be located near valves, at points where pipes penetrate walls, floors and ceilings, or at the point where piping enters and exits a vessel, tank or piece of equipment. Pipe markers shall be neatly arranged and applied squarely after pipelines are insulated and/or painted.

7. Pipe markers are not required on small equipment connections where identification is obvious.

8. Pipe markers shall be installed on exposed piping in finished public spaces.

9. Pipe markers are required in fan rooms, mechanical equipment rooms, inside central ventilation units and above all ceilings.

G. Tag automatic controls, instruments, and relays. Key to control schematic.

H. Install ductwork with plastic nameplates. Identify with air handling unit or energy recovery unit identification number and area served. Locate identification at unit, at each side of penetration of structure or enclosure, and at each obstruction.

I. Wall mount framed valve chart in the mechanical room. Provide an additional copy of chart in the Operations and Maintenance Manual.

3.3 SCHEDULE

A. Mark Schedule: Prepare valve, damper, filter, and belt schedule with directories showing the following:

1. Valve Schedule: valve number, location, type of service, equipment controlled and normal position of valve.

2. Damper Schedule: damper number, location, type of service, equipment controlled and normal position of damper.

3. Belt Schedule: Belt number, location, type of service, equipment controlled and normal frequency of changing.

4. Filter Schedule: filter number, location, MERV rating, quantity, system type of service, equipment controlled and frequency of changing.

5. Location: mounted as directed by the Owners representative.

6. A separate valve, damper, filter, and belt directory shall be provided for each major mechanical room.

END OF SECTION 23 0553

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SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of refrigerating and domestic water systems.

C. Measurement of final operating condition of HVAC systems.

1.2 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.

C. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2024, with Errata (2025).

D. NEBB (STDS) - Procedural Standard for Measurement of Sound and Vibration; 2015, with Errata (2022).

E. NEBB (TAB) - Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems; 2026.

1.3 SUBMITTALS

A. Refer to Division 01 requirements.

B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Submit to A/E.

2. Submit six weeks prior to starting the testing, adjusting, and balancing work.

3. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the A/E and other installers to sufficiently understand the design intent for each system.

4. Include at least the following in the plan:
    a. Preface: An explanation of the intended use of the control system.
    b. List of all airflow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
    c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
    d. Identification and types of measurement instruments to be used and their most recent calibration date.
    e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
    f. Final test report forms to be used.
    g. Detailed step-by-step procedures for TAB work for each system and issue, including:
        1) Terminal flow calibration (for each terminal type).
        2) Diffuser proportioning.
        3) Branch/submain proportioning.
        4) Total flow calculations.
        5) Rechecking.
        6) Diversity issues.
    h. Expected problems and solutions, etc.
    i. Details of how TOTAL flow will be determined; for example:
        1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
    j. Specific procedures that will ensure that both domestic water and air side are operating at the lowest possible pressures and methods to verify this.
    k. Confirmation of understanding of the outside air ventilation criteria under all conditions.
    l. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
    m. Method of checking building static and exhaust fan and/or relief damper capacity.

n. Proposed selection points for sound measurements and sound measurement methods.
o. Methods for making coil or other system plant capacity measurements, if specified.
p. Time schedule for TAB work to be done in phases (by floor, etc.).
q. Time schedule for deferred or seasonal TAB work, if specified.
r. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
s. Procedures for formal progress reports, including scope and frequency.
t. Procedures for formal deficiency reports, including scope, frequency and distribution.

D. Field Logs: Submit at least twice a week to the Construction Manager.

E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

F. Progress Reports.

G. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Revise TAB plan to reflect actual procedures and submit as part of final report.

2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for A/E and for inclusion in operating and maintenance manuals.

3. Provide reports in digital format manuals, complete with index page and indexing tabs, with cover identification on front. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.

5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.

6. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.

7. Include the following on the title page of each report:
    a. Name of Testing, Adjusting, and Balancing Agency.
    b. Address of Testing, Adjusting, and Balancing Agency.
    c. Telephone number of Testing, Adjusting, and Balancing Agency.
    d. Project name.
    e. Project location.
    f. Project Architect.
    g. Project Engineer.
    h. Project Contractor.
    i. Project altitude.
    j. Report date.

H. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 - PRODUCTS

2.1 PRESSURE TEST AND INFRARED THERMOGRAPHY EQUIPMENT

A. The testing agency is to supply a sufficient quantity of blower equipment that will produce a minimum of 75 Pa differential pressure between the envelope and outdoors using the test methods described herein. Supplying additional blower test equipment to provide additional airflow capacity or to act as a backup is highly recommended.

2.2 DIGITAL GAUGES AS TEST INSTRUMENTS

A. Use only digital gauges as measuring instruments in the pressure test; analog gauges are not acceptable. The gauges must be accurate to within 1.0 percent of the pressure reading or 0.15 Pa, whichever is greater. Each gauge is to be calibrated within two years of the test. The calibration is to be checked against a National Institute of Standards and Technology (NIST, formerly National Bureau of Standards) traceable standard.

2.3 THERMAL IMAGING INFRARED CAMERA REQUIREMENTS

A. The thermal imaging infrared camera used in the thermography test must have a thermal sensitivity (Noise Equivalent Temperature Difference.) of +/- 0.2°F at 18°F at 86°F or less. The camera's operating spectral range must fall between 2 and 15 micrometers. The camera's IR image viewing screen resolution must measure at least 240x180 pixels. The camera must have a means of recording thermal images seen on the camera's viewing screen. The camera is to display output as individual still frame images that can also be downloaded and inserted into an electronic

Thermographic Investigation Report. Submit the camera make and model, and catalog information that defines the camera thermal sensitivity for approval.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

1. AABC (NSTSB), AABC National Standards for Total System Balance.

2. NEBB (TAB), Procedural Standards for Testing Adjusting Balancing of Environmental Systems.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Copy A/E on any communication from the Controls Contractor and the TAB Contractor.

D. Where Owner HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

E. TAB Agency Qualifications:

1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.

2. Having minimum of three years documented experience.

3. Certified by one of the following:
   a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
   b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.

F. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.

2. Temperature control systems are installed complete and operable.

3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place. If required, install temporary media in addition to final filters.

5. Duct systems are clean of debris.

6. Fans are rotating correctly.

7. Fire and volume dampers are in place and open.

8. Air coil fins are cleaned and combed.

9. Access doors are closed and duct end caps are in place.

10. Air outlets are installed and connected.

11. Duct system leakage is minimized based on conditioned floor area (CFA).
    a. Maximum building leakage to outside ≤ 2%.
    b. Maximum Total leakage ≤ 4%.

12. Hydronic systems are flushed, filled, and vented.

13. Pumps are rotating correctly.

14. Proper strainer baskets are clean and in place.

15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.

1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to A/E to facilitate spot checks during testing.

C. Provide additional balancing devices as required.

3.4 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Plumbing Systems: Adjust to within plus or minus 10 percent of design.

3.5 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:

1. Running log of events and issues.

2. Discrepancies, deficient or uncompleted work by others.

3. Contract interpretation requests.

4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, sealing test holes, restoring insulation, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the A/E.

H. Provide a drawing indicating actual locations of all balancing dampers.

3.6 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.7 PLUMBING SYSTEM PROCEDURE

A. Adjust domestic water systems to provide required or design quantities.

B. Use calibrated orifices or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on the temperature difference across various thermometers or pressure difference across various test port points in the system.

C. Adjust systems to provide specified discharge temperature or pressure drops and flows through pipe accessories and/or equipment prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with water balancing.

D. Effect system balance with all manual angle stop valves fully closed to all plumbing fixtures.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.8 SCOPE

A. Test, adjust, and balance the following:

1. Electric Water Coolers.

2. Split System Heating/Cooling Units

3. Air Coils.

4. Terminal Heat Transfer Units.

5. Fans.

6. Air Inlets and Outlets.

3.9 MINIMUM DATA TO BE REPORTED

A. Testing and Balance Contractor shall provide personnel and instrumentation to adjust, balance, record, and submit not less than two test results (including final test) for each of the following

B. Electric Motors:

1. Identification/location.
2. Manufacturer.
3. Model/Frame.
4. HP/BHP.
5. Phase, voltage, amperage; nameplate, actual, no load.
6. RPM.
7. Service factor.
8. Starter size, rating, heater elements.
9. Sheave Make/Size/Bore.

C. Heating Coils, electric:

1. Manufacturer
2. Identification/number
3. Location
4. Model number
5. Design kW
6. Number of stages
7. Phase, voltage, amperage
8. Test voltage (each phase)
9. Test amperage (each phase)

10. Air flow, specified and actual

11. Temperature rise, specified and actual

D. Coils, Refrigerant:

1. Identification/number

2. Location

3. Service

4. Manufacturer

5. Air flow, design and actual

6. Air pressure drop, design and actual

7. Entering air DB temperature, design and actual

8. Entering air WB temperature, design and actual

9. Leaving air DB temperature, design and actual

10. Leaving air WB temperature, design and actual

11. Saturated suction temperature, design and actual

12. Condenser entering and leaving water temperatures, design and actual

13. Condenser water pressure drop, design and actual

14. Condenser water flow rate, design and actual

E. Air Moving Equipment:

1. Location.

2. Manufacturer.

3. Model number.

4. Serial number.

5. Arrangement/Class/Discharge.

6. Total Supply Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.
10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.
15. Damper positions.
16. Witnessed by the Owner's Representative.

F. Return Air/Outside Air:

1. Identification/location.
2. Design air flow.
3. Actual air flow.
4. Design return air flow.
5. Actual return air flow.
6. Design outside air flow.
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Required mixed air temperature.
11. Actual mixed air temperature.

12. Design outside/return air ratio.

13. Actual outside/return air ratio.

14. Damper positions

G. Exhaust Fans:

1. Location.

2. Manufacturer.

3. Model number.

4. Serial number.

5. Air flow, specified and actual.

6. Total static pressure (total external), specified and actual.

7. Inlet pressure.

8. Discharge pressure.

9. Sheave Make/Size/Bore.

10. Number of Belts/Make/Size.

11. Fan RPM.

H. Duct Traverses:

1. System zone/branch.

2. Duct size.

3. Area.

4. Design velocity.

5. Design air flow.

6. Test velocity.

7. Test air flow.

8. Duct static pressure.

9. Air temperature.

10. Air correction factor.

I. Duct Leak Tests: For all systems, including exterior rated ducts, medium and low pressure systems.

1. Description of ductwork under test.

2. Duct design operating pressure.

3. Duct design test static pressure.

4. Duct capacity, air flow.

5. Maximum allowable leakage duct capacity times leak factor.

6. Test apparatus:
   a. Blower.
   b. Orifice, tube size.
   c. Orifice size.
   d. Calibrated.

7. Test static pressure.

8. Test orifice differential pressure.

9. Leakage.

10. Witnessed by the Owner's Representative.

J. Terminal Heat Transfer Unit Data:

1. Manufacturer

2. Identification/number

3. Location

4. Model number

5. Size

6. Supply fan:

a. Refer to "Air Moving Equipment."

7. Electrical Coils:
   a. Refer to Heating Coils, electric.

K. Air Distribution Tests:

1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Area factor.
6. Design velocity.
7. Design air flow.
8. Test (final) velocity.
9. Test (final) air flow.
10. Percent of design air flow.
11. Witnessed by the Owner's Representative.

END OF SECTION 23 0593

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SECTION 23 0713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Duct insulation.

B. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting: Painting insulation jackets.

B. Section 23 0553 - Identification for HVAC Piping, Ductwork and Equipment.

C. Section 23 3100 - HVAC Ducts and Casings: Glass fiber ducts.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.

D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2025.

E. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).

F. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2025.

G. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers; 2015 (Reapproved 2022).

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.

I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide product description, thermal characteristics, water-vapor permeance, list of materials and thickness for each service, jackets both factory- and field-applied and locations.

C. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Detail insulation application at elbows, fittings, and accessories for each type of insulation.

3. Detail application of field-applied jackets.

4. Detail application at the linkages of control devices.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with documented experience.

1. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

2. For each product specified, provide components by the same manufacturer throughout.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, documented experience and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by the manufacturer with the appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

D. Do not install wet or water-damaged building materials.

1.8 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 0529 - Hangers and Supports for HVAC Piping, Ductwork and Equipment.

B. Coordinate clearance requirements with the duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for the installation of insulation and field-applied jackets and finishes, and for space required for maintenance.

1.9 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

1.10 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.11 WARRANTY

A. Refer to Division 01 requirements.

B. Manufacturer Warranty: Supply the manufacturer's standard warranty against defects in product workmanship and materials. Provide two-year manufacturer warranty for duct insulation, duct lining, and insulation jackets.

C. Installer Warranty: Provide one-year warranty for duct insulation, duct lining, and insulation jackets commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with the installer.

D. Warranty periods shall begin from the Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 REGULATORY REQUIREMENTS

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 C795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, FLEXIBLE

A. Manufacturer:

1. 3M.

2. Johns Manville; Microlite XG FSK: www.jm.com/#sle.

3. Knauf Insulation; Performance+ Duct Wrap: www.knaufinsulation.com/#sle.

4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

B. Insulation: ASTM C553; flexible, noncombustible blanket.

1. K value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
2. R-Value: R>6 in interior and conditioned space.
3. R-Value: ≥ R-8: Ducts in unconditioned and exterior space.
4. Minimum Density: 1 pcf. For interior and conditioned applications.
5. Maximum Density: 1.5 pcf. For interior and unconditioned applications.
6. Maximum Service Temperature: 250 degrees F.
7. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

2.3 GLASS FIBER, RIGID

A. Manufacturer:

1. 3M.
2. Johns Manville: www.jm.com/#sle.
3. Knauf Insulation: www.knaufinsulation.com/#sle.
4. Owens Corning Corporation; 700 Series FIBERGLAS Insulation: www.owenscorning.com/en-us/#sle.

B. Insulation: ASTM C612; rigid, noncombustible.

1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 350 degrees.

3. Maximum Water Vapor Absorption: 5.0 percent.

4. Minimum Density: 6 pcf. For interior and unconditioned applicaitons.

5. Maximum Density: 8.0 pcf. For exterior applicaitons.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.

2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

3. Secure with mechanical fasteners.

2.4 JACKETING AND ACCESSORIES

A. Sound Lagging:

1. Manufacturers:
   a. Acoustical Solutions.
   b. IES 2000.
   c. Oeler Industries.
   d. Sound Seal.
   e. Substitutions: Refer to Division 01 requirements.

2. Nominal Thickness: As scheduled.

3. Standard Roll: 48”W x 30’L

4. Weight: As scheduled.

5. Temperature Range: -20° to +200° F

6. R-Factor: As scheduled.

7. Flammability - Class A (or 1) Per ASTM E84.

8. Flammability / Smoke Density: 19.5

9. Flammability / Flame Spread: 12.5

B. Flexible Weather-Proofing Outdoor Jacket: Self-healing, field-applied outdoor cladding.

1. Material: Aluminum foil/polymer laminate with rubberized asphalt layer and acrylic adhesive.

2. Thickness: 34 mil, 0.034 inch.

3. Finish: Embossed.

4. Color: Silver.

5. Water Vapor Transmission: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.

6. Mold Resistance: Pass when tested in accordance with ASTM C1338.

7. Emissivity: 0.30 when tested in accordance with ASTM C1371.

8. Manufacturers:
   a. Polyguard Products; Alumaguard All-Weather: www.polyguardproducts.com.com/#sle.
   b. Substitutions: Refer to Division 01 requirements.

C. EPDM: Scrim reinforced flexible thermoplastic membrane, hot air welded. Color as selected by A/E.

2.5 FIRE-RATED DUCT WRAP

A. General: Nominal 1-1/2" thick fire-resistant wrap consisting of inorganic blanket encapsulated with scrim-reinforced foil. Wrap shall have 1-hour rating and shall be approved for 0-clearance to combustible materials.

B. Performance: Wrap shall have Flame Spread of 25 and Smoke Developed value of 50 and be tested in accordance with ASTM E84.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test ductwork for design pressure prior to applying insulation materials.

B. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting the performance of insulation application.

C. Verify that systems to be insulated have been tested and are free of defects.

D. Verify that surfaces are clean, foreign material removed, and dry.

E. 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 the insulation application.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated Ducts Conveying Air Below Ambient Temperature:

1. Provide insulation with vapor barrier jackets.

2. Finish with tape and vapor barrier jacket.

3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.

4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Ducts Exposed in Mechanical Equipment Rooms : Finish with glass fiber, rigid fiberboard insulation.

E. External Duct Insulation Application:

1. Do not compress insulation except in areas of structural interference.

2. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.

3. Secure duct with stic-clips, overlap all seams and joints, and staple. All seams, joints, and punctures in the vapor barrier shall be sealed with waterproof mastic.

4. The insulation shall be installed with all joints tightly butted or lapped and with the foil vapor barrier lapped at least 2" and taped with glass fabric tape and vapor barrier mastic.

5. Install without sag on underside of duct. Use mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.

6. Welded pins shall be used on the bottom and sides of ducts as required to prevent sagging of insulation, but in no case greater than 12" on centers.

7. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.

8. The insulation shall be applied to the duct in a manner so that standing seams, bracing, etc. will not be exposed.

9. Duct tape is not acceptable.

10. After the insulation is installed, all punctures in the vapor barrier shall be patched with glass fabric and 2 coats of mastic.

3.4 FINISHES

A. Paint all un-insulated duct work and supporting structures that are exposed to outdoor weather conditions.

B. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9.

1. Acrylic: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to paint prior to application to render fabric mildew proof.
   a. Finish Coat Material: Interior, flat, latex-emulsion size.

C. Insulation with Self-adhesive Jacket Material: Paint jacket with paint system recommended by jacket manufacturer. If manufacturer makes no recommendation the use system identified below and as specified in Section "Exterior Painting" and Section "Interior Painting."

1. Acrylic: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to paint prior to application to render fabric mildew proof.
   a. Finish Coat Material: Interior, flat, latex-emulsion size.

D. Color: Final color as indicated in mechanical identification specification. If the final color is not specified, then the color is to be selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

E. Do not field paint stainless-steel jackets or aluminum jackets that are not self-adhesive jackets.

3.5 FIELD QUALITY CONTROL

A. All insulation applications for a system type will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.6 SCHEDULES

A. Refer to the drawings.

END OF SECTION 23 0713

SECTION 23 0719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Weather barrier coatings.

C. Jacketing and accessories.

D. Engineered wall outlet seals and refrigerant piping insulation protection.

1.2 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 09 9123 - Interior Painting: Painting insulation jacket.

C. Section 23 2113 - Hydronic Piping: Placement of hangers and hanger inserts.

D. Section 23 2300 - Refrigerant Piping: Placement of inserts.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2026.

C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).

E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2026.

F. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.

G. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).

H. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.

J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

K. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

L. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).

M. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide product description, thermal characteristics, water-vapor permeance, list of materials and thickness for each service, jackets both factory and field applied and locations.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work including, but not exclusive to, the following:

1. Detail attachment and covering of heat tracing inside insulation.

2. Detail insulation application at pipe expansion joints for each type of insulation.

3. Detail removable insulation at piping specialties.

4. Detail application at linkages of control devices.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with documented experience.

1. For each product specified, provide components by the same manufacturer throughout.

B. Installer Qualifications: Company specializing in performing the products specified in this sectionwith minimum 3 years of experience.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate the quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by the Architect. Use the materials indicated for the completed Work.

1. Piping Mockups:
   a. One 10-foot section of NPS 2 straight pipe.
   b. One each of a 90-degree welded elbow.
   c. One each of a welded tee fitting.
   d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
   e. Four support hangers, including a hanger shield and insert.
   f. One threaded and flanged strainer with a removable portion of insulation.
   g. One welded, threaded, and flanged reducer.
   h. One pressure and temperature tap.
   i. One mechanical coupling.

2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.

3. Notify the Architect seven days in advance of dates and times when mockups will be constructed.

4. Obtain the Architect's approval of mockups before starting the insulation application.

5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless the Architect specifically approves such deviations in writing.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

7. Demolish and remove mockups when directed.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by the manufacturer with the appropriate ASTM standard designation, type, and grade, and maximum use temperature.

B. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

D. Do not install wet or water-damaged building materials

1.8 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 0529 - Hangers and Supports for HVAC Piping, Ductwork and Equipment.

B. Coordinate clearance requirements with the piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for the installation of insulation and field-applied jackets and finishes, and for space required for maintenance.

C. Coordinate the installation and testing of heat tracing.

1.9 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

1.10 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.11 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer Warranty: Supply the manufacturer's standard warranty against defects in product workmanship and materials. Provide one-year manufacturer's warranty for pipe insulation.

C. Installer Warranty: Provide one-year warranty for pipe insulation commencing on the Date of Substantial Completion. Complete forms in the Owner's name and register with the installer.

D. Warranty periods shall begin from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 REGULATORY REQUIREMENTS

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 C795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, FLEXIBLE

A. Manufacturers:

1. 3M.

2. Johns Manville Corporation: www.jm.com/#sle.

3. JP Lamborn Co: www.jpflex.com/#sle.

4. Knauf Insulation: www.knaufinsulation.com/#sle.

5. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

6. Manson Insulation, a company of Knauf Insulation; AK Flex with ECOSE: www.imanson.com/#sle.

B. Insulation: ASTM C553; flexible, noncombustible blanket.

1. K Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.

2. Maximum Service Temperature: 850 degrees F.

3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.

2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

D. Vapor Barrier Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film with pressure-sensitive rubber-based adhesive.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:

1. Aeroflex USA; AEROFLEX-EP: www.aeroflexusa.com/#sle.

2. GSG; Ultrafoam.

3. Halstead; Insul-tube.

4. Imcoaflex.

5. Imcolock.

6. Johns Manville Corporation; Aerotube II: www.jm.com/#sle.

7. K-Flex USA LLC; K-Flex Titan: www.kflexusa.com/#sle. For use on all outdoor piping.

8. K-Flex USA LLC; Insul-Tube: www.kflexusa.com/#sle. For use on all indoor piping.

9. Rubatex.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.

1. Value: ASTM C177; 0.28 at 75 degrees F.

2. Minimum Service Temperature: Minus 40 degrees F.

3. Maximum Service Temperature: 180 degrees F.

4. Connection: Waterproof vapor barrier adhesive.

C. Joints: All insulation shall be continuous tube-type with adhesive glued seams. Longitudinal lap-type products are not acceptable.

D. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

E. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 and UL 94 compliant. comply with ASTM C-534

F. Insulation shall be rated for use in return air plenum.

G. Product not permitted on heating hot water, chlilled water, condenser water, or dual temperature systems.

2.4 WEATHER BARRIER COATINGS

A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.

1. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.

2. Water Vapor Permeance: Greater than 1.0 perm in accordance with ASTM E96/E96M.

2.5 JACKETING AND ACCESSORIES

A. PVC Plastic.

1. Manufacturers:
   a. Johns Manville Corporation; Zeston: www.jm.com/#sle.
   b. P.I.C. Plastics; FG Series.
   c. Proto Corporation; Lo Smoke.
   d. Speedline Corporation; SmokeSafe.
   e. Substitutions: Refer to Division 01 requirements.

2. Jacket: One piece molded type fitting covers and sheet material, white color.
   a. Minimum Surface Service Temperature: 0 degrees F.
   b. Maximum Surface Service Temperature: 150 degrees F.
   c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
   d. Connections: Brush on welding adhesive.

2.6 FACTORY-FABRICATED REMOVABLE AND REUSABLE VALVE WRAPS

A. Manufacturers:

1. No Sweat Valve Wraps, Inc.

2. Thermaxx.

3. Unitherm.

B. Insulation insert: Fiberglass inserts with thickness equal to insulation on adjoining piping, minimum k-factor of .26, flame and smoke spread performance less than 25/50 per ASTM E84.

C. Outer jacket: Polyethylene coated fabric with seams joined by tabs made from hook and loop fasteners (Velcro).

2.7 ENGINEERED WALL OUTLET SEALS AND REFRIGERANT PIPING INSULATION PROTECTION

A. Basis of Design: Airex Manufacturing, Inc; www.airexmfg.com/#sle.

B. Insulation Protection System: Refrigerant piping insulation UV protective cover.

1. PVC Insulation Cover Color: Black with full-length velcro fastener.

2. Weatherization and Ultraviolet Exposure Protection: Comply with ASTM G153.

3. Water/Vapor Permeability: Comply with ASTM E96/E96M.

4. Anti-Fungal and Anti-Microbial Resistance: Comply with ASTM G21.

5. Flame Spread and Smoke Development Rating of 25/50: Comply with ASTM E84 or UL 723.

6. Tensile Strength After UV Exposure and Water Immersion: Comply with ASTM D412.

2.8 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. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 200 to 800 deg F (10 to 427 deg C).

1. 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).

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber or Glass Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
   b. - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
   d. Mon-Eco Industries, Inc.; 22-25.

2. 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).

E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
   b. - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Corning Corporation; 739, Dow Silicone.
   b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
   c. I.C. Plastics, Inc.; Welding Adhesive.
   d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.9 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.

2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

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 outdoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
   b. Marathon Industries; 570.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.

3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).

4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.

5. Color: White.

2.10 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

B. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.

3. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).

4. Color: White.

2.11 SEALANTS

A. ASJ Flashing Sealants, and Vinyl, 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 (Minus 40 to plus 121 deg C).

4. Color: White.

5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.12 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).

3. Thickness: 11.5 mils (0.29 mm).

4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Width: 3 inches (75 mm).

2. Thickness: 6.5 mils (0.16 mm).

3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

4. Elongation: 2 percent.

5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).

3. Thickness: 6 mils (0.15 mm).

4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.

5. Elongation: 500 percent.

6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches (50 mm).

2. Thickness: 3.7 mils (0.093 mm).

3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.

4. Elongation: 5 percent.

5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.13 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A240/A240M, Type 304 or Type 316 to match material in contact; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide.

2. Aluminum:ASTM B209/B209M, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, Stainless steel or Monel.

C. Wire: 062-inch soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting the performance of insulation application.

B. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

C. Verify that systems to be insulated have been tested and are free of defects.

D. Verify that surfaces are clean and dry, with foreign material removed.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. 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 (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). 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 (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Concealed Indoor Piping: Install insulation with longitudinal seams at the top of horizontal runs that are located indoors.

E. Outdoor Piping: Install insulation with longitudinal seams at the bottom of horizontal runs that are located outdoors.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Insulate the entirety of each system, including fittings, unions, flanges, valves, strainers, flexible connectors, expansion joints, expansion loops, and pump bodies.

H. PVC Jackets: Ensure that the insulation covers all exposed surfaces prior to installing the PVC jacket.

I. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

J. Fittings, Valves, and Pipe Specialties:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to the manufacturer's written instructions.

2. When premolded sections of insulation are not available, apply mitered sections of cellular-glass insulation. Secure insulation materials with wire, tape, or bands.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

5. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

K. PENETRATIONS

1. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   a. Seal penetrations with flashing sealant.
   b. 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 the joint with joint sealant.
   c. Extend the jacket of outdoor insulation outside roof flashing at least 2 inches below the top of the roof flashing.
   d. Seal the jacket to the roof flashing with flashing sealant.

2. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

3. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   a. Seal penetrations with flashing sealant.

b. 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 the joint with joint sealant.
c. Extend the jacket of outdoor insulation outside the wall flashing and overlap the wall flashing at least 2 inches (50 mm).
d. Seal the jacket to the wall flashing with flashing sealant.

L. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

M. 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 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

N. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section "Penetration Firestopping."

O. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.

P. Pipe Exposed in Mechanical Equipment Rooms or Attic : Finish with PVC jacket and fitting covers.

Q. Exterior Applications:

1. Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on the bottom side of the horizontal piping.

2. Provide two coats of UV-resistant finish for flexible elastomeric cellular insulation without jacketing.

3.4 FINISHES

A. Paint all un-insulated piping and supporting structures that are exposed to outdoor weather conditions.

B. Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section "Exterior Painting" and Section "Interior Painting."

C. Flat Acrylic Finish: Two finish coats over a primer that is compatible with the jacket material and finish coat paint. Add a fungicidal agent to render fabric mildew proof.

D. Finish Coat Material: Interior, flat, latex-emulsion size.

E. Flexible Elastomeric Thermal Insulation: After the adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

F. Color: Final color as selected by the Architect. Vary the first and second coats to allow visual inspection of the completed Work.

3.5 FIELD QUALITY CONTROL

A. All test procedures shall be followed and witnessed by an owner's representative.

B. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

C. Repair damaged insulation facings by applying the same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.6 SCHEDULE

A. Refer to drawings for type and thickness.

END OF SECTION 23 0719

SECTION 23 2113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hydronic system requirements.

B. Equipment condensate, drains and overflows.

C. Pipe hangers and supports.

D. Unions, flanges, mechanical couplings, and dielectric connections.

E. Flashing.

1.2 RELATED REQUIREMENTS

A. Section 08 3100 - Access Doors and Panels.

B. Section 23 0516 - Expansion Fittings and Loops for HVAC Piping.

C. Section 23 0523 - General-Duty Valves for HVAC Piping.

D. Section 23 0553 - Identification for HVAC Piping, Ductwork and Equipment.

E. Section 23 0719 - HVAC Piping Insulation.

F. Section 23 2114 - Hydronic Specialties.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

D. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2022.

E. ASME B31.9 - Building Services Piping; 2025.

F. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025, with Errata.

G. ASTM B32 - Standard Specification for Solder Metal; 2020.

H. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

I. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

J. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.

K. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2025a.

L. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2024.

M. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2024.

N. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020 (Reapproved 2024).

O. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.

P. ICC (IMC) - International Mechanical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Q. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.

1.4 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.

B. Use unions, flanges, or couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded connections to valves, equipment, or other apparatus.

C. Use non-conducting dielectric pipe nipple connections whenever jointing dissimilar metals. Dielectric unions are not permitted.

D. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.

E. Use full port ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

F. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

1.5 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

C. Product Data:

1. Include data on pipe materials, pipe fittings, valves, and accessories.

2. Provide manufacturers catalog information.

3. Indicate valve data and ratings.

D. Coordination Shop Drawings: In accordance with Division 1. Piping layout, 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. Other building services.

3. Structural members.

E. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, and attachments of the same to the building structure.

2. Locations of pipe anchors and alignment guides and expansion joints and loops.

3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.

4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.6 CLOSEOUT SUBMITTALS

A. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

B. Project Record Documents: Provide ditigal and minimum half size set of drawings of building floor plan with all valves clearly labeled and shown in as-built locations. Provide two copies to Owner Record.

C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with documented experience.

C. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.8 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 code for installation of piping system.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.10 WARRANTY

A. Refer to Division 01 requirements.

B. Manufacturer Warranty: Supply the manufacturer's standard warranty against defects in product workmanship and materials. Provide two-year manufacturer's warranty for all hydronic piping.

C. Installer Warranty: Provide two-year warranty for all hydronic piping commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with the installer.

D. Warranty periods shall begin from the Date of Substantial Completion.

E. Correct defective work within a five year period after Substantial Completion.

PART 2 - PRODUCTS

2.1 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:

1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.

2. Use non-conducting dielectric pipe nipple connections whenever jointing dissimilar metals. Dielectric unions are not permitted.

3. Grooved mechanical joints may be used in accessible locations only.
   a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by A/E.
   b. Use rigid joints unless otherwise indicated.

4. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, brazed, or soldered connections.

D. Valves: Provide valves where indicated:

2.2 EQUIPMENT CONDENSATE, DRAINS, AND OVERFLOWS

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

2. Joints: Solder, lead free, ASTM B32, HB alloy (95-5 tin-antimony), or tin and silver.

B. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.

1. Fittings: ASTM D2466 or D2467, PVC.

2. Joints: Solvent welded in accordance with ASTM D2855.

2.3 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Conform to ASME B31.9.

1. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.

2. Hangers for Cold Pipe Sizes 2 Inches and Greater: Carbon steel, adjustable, clevis.

3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

4. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

5. Wall Support for Pipe Sizes 4 Inches and Greater: Welded steel bracket and wrought steel clamp.

6. Vertical Support: Steel riser clamp.

7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

8. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

9. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

C. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.4 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe of 2 Inches and Less:

1. Ferrous Piping: 150 psi brass or malleable iron, threaded.

2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe 2 Inches and Greater:

1. Ferrous Piping: 150 psig forged steel, slip-on.

2. Copper Piping: Bronze.

3. Gaskets: 1/16 inch thick, preformed neoprene.

2.5 FLASHING

A. Flashing for pipes passing through the roof shall be provided as indicated on the drawings or as approved by the A/E.

2.6 TESTING EQUIPMENT

A. Provide all materials, test equipment, instruments, and labor required for the tests. All instruments shall be properly calibrated and shall have records on calibration.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify location of existing structures and utilities prior to excavation.

B. Verify soil composition and rock depth, if any, before beginning excavation.

C. Protect adjacent structures from the effects of excavation.

D. Notify Architect of unsatisfactory conditions.

E. Do not proceed with installation until unsatisfactory conditions have been corrected.

F. Coordinate all exterior buried pipe work with site utilities, grading, site backfilling, and foundation construction, and other site disturbances.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment using jointing system specified.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems. See Section 23 2500 for additional requirements.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install refrigerant piping to ASME B31.5 requirements.

C. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

D. Route piping in orderly manner, parallel to building structure, and maintain gradient.

E. Install piping to conserve building space and to avoid interference with use of space.

F. Group piping whenever practical at common elevations.

G. Sleeve pipe passing through partitions, walls, and floors.

H. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

I. Slope piping and arrange to drain at low points.

J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 23 0516.

K. Pipes shall not cross any designated roof walkways. If they must cross a walkway, a permanently accessible and readily removable platform and/or stairs shall be provided over the piping.

L. Install clean-out tees in all equipment drain piping in lieu of elbows.

M. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

N. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.

2. Support horizontal piping as scheduled.

3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.

4. Place hangers within 12 inches of each horizontal elbow.

5. Use hangers with 1-1/2 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.

7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

8. Provide copper plated hangers and supports for copper piping.

9. Prime coat exposed steel hangers and supports. See Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

O. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 23 0719.

P. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. See Section 09 9123.

1. Paint all un-insulated piping and supporting structures that are exposed to outdoor weather conditions.

Q. Install valves with stems upright or horizontal, not inverted.

3.4 SCHEDULES

A. Pipe Hanger Spacing: In accordance with the ICC (IMC).

3.5 FIELD QUALITY CONTROL

A. Hydronic Pressure Testing:

1. Prepare steam and condensate piping according to ASME B31.9, "Building Services Piping,"

2. Leave joints, including welds, uninsulated and exposed for examination during test.

3. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

4. Flush system with clean water. Clean strainers. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

5. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment. Do not subject equipment to test pressure.

6. Install relief valve set at pressure no more than one-third higher than test pressure.

7. Use vents installed at high points to release trapped air while filling system. Use drip legs installed at low points for complete removal of liquid.

8. Subject the piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure or 150 psi whichever is higher. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of the specified minimum yield strength.

9. After hydrostatic test pressure has been applied for at least 4 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components with new materials, and repeat hydrostatic test until there are no leaks.

10. Liquid Penetrant (PT) examination can be performed for welds onto existing piping which cannot be hydrostatic tested. Indications with major dimensions greater than 1/16 of an inch will be rejected. The following indications are unacceptable and will be rejected:
    a. Any cracks or linear indications.
    b. Rounded indications with dimensions greater than 3/16 inch.
    c. our or more rounded indications in a line separated by 1/16 inch or less edge-to-edge

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Give seven days' advance notice for testing to all associated parties including the Architect, Engineer, Owners representative, and AHJ.

2. All piping pressure and leak testing shall be coordinated to be witnessed by Owner representative and the TAB contractor.

C. H. Prepare test and inspection reports.

1. The contractor shall submit a certificate from the manufacturer stating that the installation conforms to the recommended installation procedures.

3.6 CLEANING

A. Prior to occupancy and building turnover complete system flush sequence containing the following:

B. Fill system. Run system for continuous operations with all two-valves fully closed and all 3-way valves fully open for the duration specified in the HVAC Water Treatment Section. Check and clean all strainers.

C. Refill System and run all equipment in continuous operations with all valves fully opened for the duration specified. Check and clean all strainers.

END OF SECTION 23 2113

SECTION 23 2300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping.

B. Refrigerant.

C. Moisture and liquid indicators.

D. Flashing.

E. Pressure Testing.

1.2 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 09 9123 - Interior Painting.

C. Section 23 0719 - HVAC Piping Insulation.

D. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. AHRI 710 (I-P) - Performance Rating of Liquid-Line Driers; 2009.

C. AHRI 711 (SI) - Performance Rating of Liquid-Line Driers; 2009.

D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Addendum (2026).

E. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2024, with Addendum (2025).

F. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2022.

G. ASME B31.9 - Building Services Piping; 2025.

H. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2023.

I. ASTM C1427 - Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form; 2025.

J. ASTM E966 - Standard Guide for Field Measurements of Airborne Sound Attenuation of Building Facades and Facade Elements; 2018a.

K. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2026.

L. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.

M. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

C. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.

D. Test Reports: Indicate results of leak test, acid test.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

B. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 3 years of documented experience.

1. Properly certified technicians shall perform all work and shall have proof of certification with them at all times when they are on the job site.

2. Documentation for all technician certifications shall be filed with the Owner's HVAC manager.

B. Tester Qualifications: Company specializing in performing the type of work specified in this section. All pressure tests shall be conducted by qualified personnel. When requested the qualifications of individuals shall be submitted to the A/E for approval.

1.7 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 for installation of piping system.

B. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

C. All refrigerant work (including disposal) shall comply with EPA Section 608 regulations.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

1.9 NOTIFICATION

A. The A/E shall be notified at least 7 days prior to all tests.

1.10 WARRANTY

A. Refer to Division 01 for additional warranty requirements.

B. Manufacturer Warranty: Supply manufacturer's standard warranty against defects in product workmanship and materials. Provide two-year manufacturer warranty for refrigerant piping.

C. Installer Warranty: Provide two-year warranty for refrigerant piping commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with the installer.

D. Warranty periods shall begin from Date of Substantial Completion.

E. Correct defective work within a five year period after Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure integrity of system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.

C. Liquid Indicators:

1. Use line size liquid indicators in main liquid line leaving condenser.

2. If receiver is provided, install in liquid line leaving receiver.

3. Use line size on leaving side of liquid solenoid valves.

D. Valves:

1. Use service valves on suction and discharge of compressors.

2. Use gauge taps at compressor inlet and outlet.

E. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.

F. Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.

G. Filter-Driers:

1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.

2. Each liquid line shall be provided with a dryer as specified in the equipment section. Provide all necessary valves to isolate dryer to allow service without losing entire system charge.

H. Provide piping accessories and specialties as recommended and required by the refrigeration equipment manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Comply with ASME B31.9 for installation of piping system.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

C. Welders Certification: In accordance with ASME BPVC-IX.

D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

2.3 PIPING

A. Gel Copper Tube: Seamless soft copper tube Manufactured according to ASTM B280 C12200 DHP 99.9% pure.

1. Joints: Braze: AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.

2. Insulation: ASTM C1427 compliant. Low Density Polyethylene Closed Cell Foam
   a. Type I (tubular)
   b. Grade I (insulation material for use on typical commercial system non-crosslinked)
   c. CFC and HCFC gas free
   d. Water vapor permeability: ASTM E966 ASTM E96-00 compliant
   e. Working temperature: ASTM C1427 compliant from -94 F to +250 F with Wall thickness: 1/2”, 3/4” and 1”
   f. Surface burning characteristics: UL 723 CLASSIFIED R39562 (ASTM E84 25/50), surface burning characteristics: flame spread 0, smoke developed 10. UL 94, top rated.
   g. R-Value: between 9.0 and 4.0 (depending on pipe diameter and insulation thickness)
   h. UV: This product is UL PERFORMANCE VERIFIED for UV exposure (visit:https://verify.ul.com) and successfully tested internally for UV resistance against any major degradation,

3. Where 2 pipe systems are used provide twin gel copper kit. Refer to manufacturer sizing criteria.

4. Special Features:
   a. Outer Jacket: Additional white polyethylene jacket cover protects foam insulation from tearing during the installation process.
   b. Foot Marking: Insulation incrementally marked by every foot to ensure accurate initial unit charge and reduce copper waste
   c. Paintable: The insulation can be painted to match the surroundings.

B. Pipe Supports and Anchors:

1. Provide hangers and supports complying with MSS SP-58.
   a. All refrigerant piping shall be installed using only trapeze type of hangers for support.
   b. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.

3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

5. Vertical Support: Steel riser clamp.

6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

7. Hanger Rods: continuous threaded or mild steel threaded both ends.

8. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 REFRIGERANT

A. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) no greater than that allowed by federal code.

B. Refrigerant: R-454B or R-32 as defined in ASHRAE Std 34.

C. Refer to manufacturer product data, specifications, installation and operation manual for refrigerants used during bidding and procurement of equipment. Refrigerant phase-out is in progress.

2.5 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, flared or soldered ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.6 FILTER-DRIERS

A. Performance:

1. Flow Capacity - Liquid Line: As indicated in schedule, minimum, rated in accordance with AHRI 710 (I-P) (AHRI 711 (SI)).

2. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.

3. Design Working Pressure: 350 psi, minimum.

B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.

C. Construction: UL listed.

1. Connections: As specified for applicable pipe type.

2.7 FLASHING

A. Flashing for pipes passing through the roof shall be provided as indicated on the drawings or as approved by the A/E.

2.8 TESTING EQUIPMENT

A. Provide all materials, test equipment, instruments, and labor required for the tests. All instruments shall be properly calibrated and shall have records on calibration.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Some refrigerant line lengths and/or vertical lifts may exceed manufacturer's recommendations. Mechanical contractor is responsible for insuring the equipment manufacturer sizes all refrigerant lines for these pieces of equipment. Provide suction line accumulators and solenoid valves near the expansion valve if necessary.

C. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and avoid interference with use of space.

E. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Pipes shall not cross any designated roof walkways. If they must cross a walkway, a permanently accessible and readily removable platform and/or stairs shall be provided over the piping.

H. Piping within chases in building shall be one piece, no joints will be allowed in hidden or inaccessible areas.

I. Soft copper roll with preinsulated to be provided for all concealed indoor piping.

J. Refrigerant suction piping shall be trapped at each indoor unit.

K. Prior to equipment installation, all refrigerant lines shall be capped and never open to the environment.

L. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.5.

2. Support horizontal piping as indicated.

3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

4. Place hangers within 12 inches of each horizontal elbow.

5. Where several pipes can be installed in parallel and at same elevation, provide common trapeze hangers.

6. Provide copper plated hangers and supports for copper piping.

M. Provide clearance for installation of insulation and access to valves and fittings.

N. Flood piping system with nitrogen when brazing.

O. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

P. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

Q. Fully charge completed system with refrigerant after testing.

R. Provide electrical connection to solenoid valves. See Section 26 0583.

3.3 FIELD QUALITY CONTROL

A. Refer to Division 01 requirements.

B. Refrigerant Pressure Testing

1. After refrigerant piping has been completed and before insulating pipe and enclosing chases, the field-installed piping shall be pressure tested at a pressure tested.

2. Test refrigeration system in accordance with ASME B31.5.

3. Pressure test system with dry nitrogen to 250 psi for 24 hour hours. Perform final tests at 27 inches vacuum and 250 psi using halide torch. Test to no leakage.
   a. While the system is being pressure tested, an electronic leak detector shall be used to check for leaks.
   b. All field-installed piping shall be evacuated when the surrounding ambient air is not less than 60 degrees F.
   c. A minimum vacuum of 2.0 mm of mercury shall be pulled on the piping system and maintained for the duration of the test. The vacuum

pressure displacement shall be not less than 5 CFM. The vacuum shall be checked with an electronic gauge.

4. An approved Owner's representative shall witness this pressure test. Once the test is completed successfully, the lines may be covered and the equipment installed.

5. On existing buildings when split systems are added, this pressure test may be waived if approved by Owner's HVAC department.

C. Condenstate Leak Testing

1. Prepare condensate piping according to ASME B31.9, "Building Services Piping,"

2. Leave joints and fittings uninsulated and exposed for examination during test.

3. Flush system with clean water. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

4. Use vents installed at high points to release trapped air while filling system. Use drip legs installed at low points for complete removal of liquid.

D. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Give seven days' advance notice for testing to all associated parties including the A/E and AHJ.

2. All test procedures shall be followed and witnessed by an owner's representative.

E. Prepare test and inspection reports.

1. The contractor shall submit a certificate from the manufacturer stating that the installation conforms to the recommended installation procedures.

3.4 SCHEDULES

A. Refer to the equipment manufacturer for refrigerant pipe sizing based on length and capacity.

B. Hanger Spacing for Soft Copper Tubing.

1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 3 feet; minimum rod size, 1/4 inch.

2. 1-1/8 inch OD: Maximum span, 4 feet; minimum rod size, 1/4 inch.

3. 1-3/8 inch OD: Maximum span, 5 feet; minimum rod size, 3/8 inch.

4. 1-5/8 inch OD: Maximum span, 6 feet; minimum rod size, 3/8 inch.

C. Hanger Spacing for Hard Copper Tubing.

1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.

2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.

3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.

4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.

5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.

6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.

7. 3-1/8 inch OD: Maximum span, 10 feet; minimum rod size, 3/8 inch.

8. 3-5/8 inch OD: Maximum span, 11 feet; minimum rod size, 1/2 inch.

9. 4-1/8 inch OD: Maximum span, 12 feet; minimum rod size, 1/2 inch.

END OF SECTION 23 2300

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SECTION 23 3100 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal ducts.

B. Flexible ducts.

C. Air plenums and casings.

D. Flashing.

E. Pressure testing.

F. Duct cleaning.

1.2 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 09 9113 - Exterior Painting: Weld priming, weather resistant, paint or coating.

C. Section 09 9123 - Interior Painting: Weld priming, paint or coating.

D. Section 23 3200 - HVAC Air-Distribution System Cleaning: Post install duct cleaning.

E. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.

F. Section 23 0713 - Duct Insulation: External insulation and duct liner.

G. Section 23 3300 - Air Duct Accessories.

H. Section 23 3700 - Air Outlets and Inlets: Fabric air distribution devices.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.

C. ASHRAE Std 62.1-2010 - Ventilation for Acceptable Indoor Air Quality; 2010.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2026.

G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.

I. NADCA ACR - The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC Systems; 2025.

J. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.

K. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2027.

L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

M. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines; 2001.

N. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.

O. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

1.4 PERFORMANCE REQUIREMENTS

A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA (DCS)

"HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA (DCS) "HVAC Duct Construction Standards - Metal and Flexible"

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE Std 62.1-2010.

D. No variation of duct configuration or sizes is permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with the ASHRAE table of equivalent rectangular and round ducts.

1.5 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide data for duct materials, Liners and adhesives, and Sealants and gaskets.

C. Shop Drawings: Digital generated coordination drawing at an appropriate scale for the project Indicating the entire ductwork systems including duct fittings, particulars such as gages, sizes, elevations, reinforcement and spacing, seam and joint construction, welds, and configuration prior to start of work for 1 pressure class and higher systems. Sheet Metal coordinated shop drawings shall be submitted for review and approval to indicate the following

1. Length, width, height and elevation of bottom of each duct segment

2. Sheet metal gauge

3. Clearly indicated locations of fire dampers (FD), smoke dampers (SD), combination fire/smoke dampers (FSD), motorized dampers (MD), manual balancing dampers, and remote balancing dampers.

4. Transition segments marked with entrance and exit sizes, as well as length and elevation

5. Indication of duct offsets in the horizontal or vertical direction

6. Duct lining thickness, including, if it changes, where it changes.

7. Any constraints or points of conflict due to existing conditions or planned piping, conduit, structure, or finish which will interfere with the installation of the ductwork

D. Delegated-Design Submittal:

1. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.

1.6 CLOSEOUT SUBMITTALS

A. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate per appropriate seal class, following SMACNA (LEAK).

1. Test all exterior rated ducts, and all medium and low pressure ductwork systems.

2. All duct work pressure testing shall be coordinated to be witnessed by Owner representative and the TAB contractor.

B. Project Record Documents: Record actual locations of ducts, dampers, and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with documented experience. Provide welding certificates.

C. Tester Qualifications: Company specializing in performing the type of work specified in this section. All duct leakage and duct cleanliness tests shall be conducted by qualified personnel. When requested the qualifications of individuals shall be submitted to the Architect for approval

1.8 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

1.9 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

C. All duct shall be stored and secured to prevent damage from precipitation and surrounding construction. Maintain duct section seals prior to installation.

D. All ductwork shall be sealed onsite and no tape shall be used to seal ductwork.

1.10 NOTIFICATIONS

A. The A/E shall be notified a minimum of 7 days prior to all tests.

1.11 WARRANTY

A. Refer to Division 01 for additional warranty requirements.

B. Manufacturer Warranty: Supply manufacturer's standard warranty against defects in product workmanship and materials. Provide one-year manufacturer warranty for metal ducts and casings.

C. Fabric Ducts: Provide a 10 year manufacturer's warranty for products supplied for the fabric portion of this system as well as a design and performance warranty.

D. Installer Warranty: Provide one-year warranty for metal ducts and casings commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with the installer.

E. Warranty periods shall begin from Date of Substantial Completion.

F. Correct defective work within a five year period after Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.

B. Provide metal duct unless otherwise indicated.

C. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 23 3319.

D. Duct Shape and Material in accordance with Allowed Static Pressure Range:

1. Round: Plus or minus as indicated on the drawings of galvanized steel.

2. Rectangular: Plus or minus as indicated on the drawings of galvanized steel.

3. Flexible Duct (Fabric and wire): Plus or minus 2 in-wc; see Section 23 3700.

E. Duct Sealing and Leakage in accordance with Static Pressure Class:

1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
   a. Refer to the drawings for scheduled pressure class. and material.
   b. Supply Air: as indicated on the drawings pressure class, galvanized steel.
   c. Outside Air Intake: 1 in-wc pressure class, galvanized steel.
   d. Return and Relief Air: 1 in-wc pressure class, galvanized steel.
   e. General Exhaust Air: as indicated on the drawings pressure class, galvanized steel.

2. Low Pressure Service: Up to 2 in-wc:
   a. Seal: Class B, apply to seal off transverse joints.
   b. Leakage:
      1) Rectangular: Class 24 or 24 cfm/100 sq ft.
      2) Round: Class 12 or 12 cfm/100 sq ft.

3. Medium and High Pressure Service: Above 2 in-wc:
   a. Seal: Class A, apply sealing of transverse joints, longitudinal seams, and duct wall penetrations.
   b. Leakage:
      1) Rectangular: Class 6 or 6 cfm/100 sq ft.
      2) Round: Class 3 or 3 cfm/100 sq ft.

F. Duct Fabrication Requirements:

1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded rectangle, round, and oval duct fittings.

2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.

3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.

4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.

5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

6. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.

7. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.2 METAL DUCTS

A. Material Requirements:

1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

2. Aluminum: ASTM B209/B209M, aluminum sheet, alloy 3003-H14.

B. Rectangular Metal Duct:

1. Rectangular Single Wall: Rectangular, longitudinal lock seam duct with galvanized steel wall.

C. Round Metal Ducts:

1. Round Single Wall Duct: Round lock seam duct with galvanized steel outer wall.
   a. Provide conical tap fittings for all round ductwork, unless noted otherwise.
   b. Provide high-efficiency rectangular to round takeoff where the branch duct is the same depth or larger than the main.
   c. Provide sprin-in fittings with integral manual volume balancing damper for branch takeoffs located above an accessible acoustical ceiling tile (ACT) or hard gyp ceiling with an access panel.

2. Round Connection System: Interlocking duct connection system in accordance with SMACNA (DCS).

D. Connectors, Fittings, Sealants, and Miscellaneous:

1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.

2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).

3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
   a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
   b. VOC Content: Not more than 250 g/L, excluding water.
   c. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
   d. For Use with Flexible Ducts: UL labeled.
   e. Manufacturers:
      1) Carlisle HVAC Products; Hardcast Versa-Grip 181 Water Based Fiber Reinforced Duct Sealant: www.carlislehvac.com/#sle.
      2) Design Polymerics; DP 1010 Water Based Smooth Duct Sealant, Premium Quality: www.designpoly.com/#sle.
      3) Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
      4) Elgen Manufacturing Company, Inc; Duct Sealer: www.elgenmfg.com/#sle.
      5) H.B. Fuller Construction Products, Inc: www.fosterproducts.com//#sle.
      6) Red Devil; D-Seal.

4. Gasket Tape:
   a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.
   b. Manufacturers:
      1) Design Polymerics; DP 1040 100 Percent Solids, High Pressure/High-Velocity Butyl Gasket Tape: www.designpoly.com/#sle.

2) Ductmate Industries, Inc, a DMI Company; DM 440: www.ductmate.com/#sle.
3) Elgen Manufacturing Company, Inc; 440 Butyl Gasket Tape: www.elgenmfg.com/#sle.

c. VOC Content: Not more than 250 g/L, excluding water.

E. Manufacture in accordance with SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

2.3 FLEXIBLE DUCTS

A. Flexible Air Ducts:

1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.

2. Insulation: Fiberglass insulation with aluminized vapor barrier film.

3. Pressure Rating: From 6 in-wc to 1 in-wc negative.

4. Maximum Velocity: 4,000 fpm.

5. Temperature Range: Minus 20 to 210 degrees F.

6. Manufacturers:
   a. Flexmaster USA, a brand of Masterduct, Inc; Type 9: www.flexmasterusa.com/#sle.
   b. JP Lamborn Co; Silver Jacket MHP: www.jplflex.com/#sle.
   c. Thermaflex; M-KC.
   d. Substitutions: See Section 01 6000 - Product Requirements.

2.4 AIR PLENUMS AND CASINGS

A. Fabricate in accordance with SMACNA (DCS) for indicated operating pressures indicated.

B. Minimum Fabrication Requirements:

1. Fabricate acoustic plenum or casing with reinforcing turned inward.

2. Provide 16-gauge, 0.059-inch sheet steel back facing and 22-gauge, 0.029-inch perforated sheet steel front facing with 3/32 inch diameter holes on 5/32 inch centers.

3. Construct panels 2 inches thick, packed with 4.5 pcf minimum glass fiber insulation media, on inverted channel of 16-gauge, 0.059-inch sheet steel.

4. Mount floor-mounted plenum or casings on 4-inch high concrete curbs. At floor, rivet panels on 8-inch centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18-gauge, 0.052-inch expanded metal mesh supported at 12-inch centers, turned up 12 inches at sides with sheet metal shields.

C. Access Doors:

1. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.

2. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.

3. Provide clear wire glass observation ports, minimum 6 by 6 inch size.

2.5 FLASHING

A. Ductwork and HVAC Equipment: Cap flashing for all ducts and other types of ventilating equipment which pass through or mount on the roof. The material shall be of the same materials as the ducts, etc. to which it shall be fastened unless otherwise noted.

2.6 TESTING EQUIPMENT

A. Provide all materials, test equipment, instruments, and labor required for the tests. All instruments shall be properly calibrated and shall have records on calibration.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install products following the manufacturer's instructions.

C. Install ducts with fewest possible joints.

D. Install factory-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with sufficient clearance, plus allowance for insulation thickness.

H. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.

I. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

J. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.

K. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.

L. Do not provide duct take-offs within 6" of the supply plenum or supply trunk cap.

M. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

N. Duct shall not cross any designated roof walkways. If they must cross a walkway, a permanently accessible and readily removable platform and/or stairs shall be provided over the piping.

O. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with a crimp in the direction of airflow.

P. Use double nuts and lock washers on threaded rod supports.

Q. Connect supply air diffusers to low pressure ducts directly or with 3 to 6 ft maximum length of flexible duct held in place with strap or clamp. Do not use a flexible duct to change direction.

R. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

S. Fire Partitions: Provide firestopping sealing. See Section 07 8400.

T. Duct Accessories, Terminal Units, Inlets, and Outlets: Interconnect as indicated in Sections 23 3300, 23 3600, and 23 3700.

U. Duct Insulation: Provide duct insulation. See Section 23 0713.

V. Painting: Provide surface finish as indicated on drawings. See Sections 09 9113 and 09 9123.

1. Paint all un-insulated duct work and supporting structures that are exposed to outdoor weather conditions.

2. Where the interior of any duct is exposed to view or can reflect light as viewed from a habitable space the interior surfaces shall be primed and painted flat black or as otherwise approved by the A/E.

W. Vibration Isolation Hangers and Supports: Refer to 23 0548

X. Duct Isolation

1. Ducts shall be connected to fans and fan casings by means of flexible connectors. Flexible connectors shall be installed to prevent metal-to-metal contact across flexible connection. Flexible duct connectors shall not be used outside the mechanical room unless expressly shown on the drawings.

Y. Ductwork Bracing

1. Do not install tie rods within ducts serving noise critical spaces.

Z. Duct Penetrations

1. Where each duct passes through a noise critical wall, floor or ceiling surrounding any noise critical spaces, there shall be a clear annular space of 1 inch between the duct and structure. After all of the ductwork is installed the Contractor shall check the clearance, pack the voids full depth with mineral fiber batt insulation and caulk both ends with a non aging, non hardening sealant backed by a polyethylene foam rod or permanently flexible firestop material.

2. Where there is not sufficient access space to pack around all sides of a duct (for example, at the underside of a slab), place a short stub duct in the wall, pack and caulk around it and then attach the inlet and outlet ducts to each end.

3. The cap flashing shall be made tight to the duct, waterproofed, and extended over the base flashing and down the side for not less than 4 inches. The cap

flashing shall be formed to provide a spring action against the base flashings. In cases of dissimilar metals between the cap and base flashings, an isolation membrane shall be installed to prevent electrolysis.

4. Flashing shall be provided at all ductwork penetrations through the penthouse and attic mechanical room floor.

3.2 FIELD QUALITY CONTROL

A. All work shall be subject to constant inspection and final approval of the A/E and all Code authorities having jurisdiction.

B. Perform tests and inspections, required to prove Code compliance shall be provided as required by the Authorities without additional cost to the Owner

C. Leakage Tests:

1. Leakage test procedures shall follow the SMACNA (LEAK) "HVAC Air Duct Leakage Test Manual," newest edition. Submit a sample test report for each test.

2. Test the systems that are scheduled or indicated on the drawings to be tested.
   a. Single-Zone Systems:
      1) 100% of low pressure Supply, Return, and Exhaust sheet metal ducts for 2" and larger pressure class AHU systems.
      2) 25% of low pressure Supply and Return sheet metal ducts for 1" and smaller pressure class FCU systems.
   b. Exhaust Fans systems:
      1) 25% of low pressure Exhaust sheet metal branch ducts.
   c. Fiberglass and Fabric ductwork does not require pressure testing.

3. Supply, Return, and Exhuast ducts shall be tested with a calibrated orifice and fan before diffusers, grilles, and registers and ceiling are installed.

4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

5. Conduct tests at static pressures equal to the listed pressure class of the system or section being tested. Do not pressurize systems above the listed pressure class.

6. Test for leaks before applying external insulation.

7. Give seven days' advance notice for testing to all associated parties including the A/E and AHJ.

8. All duct work pressure testing shall be coordinated to be witnessed by Owner representative and the TAB contractor.

9. Supply, Return, and Exhaust ducts shall be tested and verified to the following performance:
   a. Low pressure sheet metal duct losses shall not exceed 10% of the design system CFM at the pressure class indicated on the drawings. Seal if required.
   b. Medium pressure ducts shall be tested as recommended by SMACNA Manual. Sheet metal duct losses shall not exceed 10% of the design system CFM the pressure class indicated on the drawings. Seal if required.

D. Duct System Cleanliness Tests:

1. Visually inspect all duct systems to ensure that no visible contaminants are present.

2. Test sections of the metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
   a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

3. Duct system will be considered defective if it does not pass tests and inspections.

4. Prepare test and inspection reports.

E. Establish that the ductwork is sealed and clean, or clean duct system(s), before testing, adjusting, and balancing.

F. All work found to be defective or indicating leakage shall be repaired or replaced with new materials, as directed by the A/E. Tests shall be repeated until all work is proven tight.

3.3 CLEANING

A. Clean thoroughly each duct system. See Section 23 3200.

B. Clean new duct system(s) before testing, adjusting, and balancing if and only if the system is considered defective from the duct cleanliness testing.

C. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

D. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined ducts. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23, Section "Air Duct Accessories" for access panels and doors.

2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.

3. Remove and reinstall ceiling to gain access during the cleaning process.

E. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.

2. When venting vacuuming system to outdoors, use a filter to collect debris removed from the HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into the building.

F. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.

3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.

4. Coils and related components.

5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.

6. Supply-air ducts, dampers, actuators, and turning vanes.

7. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from the building.

2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to the downstream end of duct sections so areas being cleaned are under negative pressure.

3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging the integrity of metal ducts, duct liner, or duct accessories.

4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.

5. Clean coils and coil drain pans according to NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if the fungus is present. Apply antimicrobial agents according to the manufacturer's written instructions after removal of surface deposits and debris.

8. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
   a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
   b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.

9. Cleaning Mineral-Fiber Insulation Components:
    a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR.
    b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests.
    c. Fibrous materials that become wet shall be discarded and replaced.

END OF SECTION 23 3100

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SECTION 23 3200 - HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cleaning of HVAC duct system, equipment, and related components.

1.2 DEFINITIONS

A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, coils, and condensate drain pans; see NADCA ACR for more details.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. NADCA ACR - The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC Systems; 2025.

C. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

D. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Manufacturer's data sheets on each product to be used.

C. Qualifications Statement: Submit qualifications of proposed cleaning contractor for approval.

D. Qualifications Statement: Submit qualifications of proposed testing and inspection agency for approval.

E. Project Cleanliness Evaluation and Cleaning Plan, as specified.

F. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to Owner.

G. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

1.5 QUALITY ASSURANCE

A. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.

1. Certified by one of the following:
   a. NADCA, National Air Duct Cleaners Association: www.nadca.com.

2. Having minimum of three years documented experience.

3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

PART 2 - PRODUCTS

2.1 TOOLS AND EQUIPMENT

A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.

B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.

C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

2.2 SURFACE TREATMENTS

A. Anti-Microbial Materials: EPA registered specifically for use on non-porous HVAC system surfaces and applied per manufacturer's instructions.

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

A. Comply with applicable federal, state, and local requirements.

B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.

C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.

D. Obtain Owner's approval of proposed temporary locations for large equipment.

E. Designate a decontamination area and obtain Owner's approval.

F. If unforeseen mold or other biological contamination is encountered, notify A/E immediately, identifying areas affected and extent and type of contamination.

3.2 EXAMINATION

A. Inspect the system as required to determine appropriate methods, tools, equipment, and protection.

B. Start of cleaning work constitutes acceptance of existing conditions.

C. When concealed spaces are later made accessible, examine and document interior conditions prior to beginning cleaning.

D. Document all instances of mold growth, rodent droppings, other biological hazards, and damaged system components.

3.3 PREPARATION

A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.

B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.

C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning.

D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.

1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.

2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.

3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.

E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.4 CLEANING

A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.

B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.

C. Ducts: Mechanically clean all portions of ducts.

1. Existing Ducts: Mechanically clean all portions of existing ducts.

2. New Ducts: Mechanically clean portions of new ducts, where sections did not pass visual inspection per the owner's recommendation.

D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.

E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.

F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove refrigeration coils from system to clean; report coils that are permanently impacted.

G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.

H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.5 REPAIR

A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.

B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.

C. Reseal new openings in accordance with NADCA Standard 05.

D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.

E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.6 FIELD QUALITY CONTROL

A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.

B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.

C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.

D. Notify A/E when cleaned components are ready for inspection.

E. When directed, re-clean components until they pass.

F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.7 ANTI-MICROBIAL TREATMENT

A. When directed, apply anti-microbial treatment to internal surfaces.

B. Apply anti-microbial agent after removal of surface deposits and debris.

C. Apply anti-microbial treatments and coatings in strict accordance with the manufacturer's written recommendations and EPA registration listing.

D. Spray coatings directly onto interior ductwork surfaces; do not "fog" into air stream.

3.8 ADJUSTING

A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.

3.9 WASTE MANAGEMENT

A. Double-bag waste and debris in 6 mil, 0.006 inch thick polyethylene plastic bags.

B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 23 3200

SECTION 23 3300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Air turning devices/extractors.

B. Backdraft dampers - metal.

C. Duct access doors.

D. Duct test holes.

E. Flexible duct connectors.

F. Volume control dampers.

G. Low leakage (Class 1A) control dampers.

H. Miscellaneous Products:

1. Duct opening closure film.

1.2 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 23 3100 - HVAC Ducts and Casings.

C. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.

C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.

F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2027.

G. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

H. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

1.4 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide for shop fabricated assemblies including volume control dampers and duct access doors. Include electrical characteristics and connection requirements.

1. Include leakage, pressure drop, and maximum pressure data.

2. Indicate materials, construction, and dimensions.

3. Include a copy of the Installation Instructions.

C. Shop Drawings: Indicate locations for shop fabricated assemblies including duct accessories, volume control dampers, turning vanes, duct access doors, and duct test holes. Include plans, elevations, sections, details and attachments to other work. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

1. Special fittings.

2. Manual volume damper installations.

3. Control-damper installations.

4. Fire-damper, combination fire and smoke damper, and ceiling damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

5. Wiring Diagrams: For power, signal, and control wiring.

6. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Drawings: Record actual locations of access doors and test holes.

B. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Fusible Links: Two of each type and size.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with documented experience.

1. For each product specified, provide components by the same manufacturer throughout.

2. Damper pressure drop ratings shall be based on tests and procedures performed in accordance with AAMCA 500-D.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

C. Maximum leakage through the exterior walls of any accessory shall be 6 cfm per 100 square feet of surface area at 2 in. w. c. test pressure.

D. All shafts penetrating ductwork walls shall have seals.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

B. Storage: Store materials in a dry area indoors, protected from damage and in accordance with the manufacturer's instructions.

C. Handling: Handle and lift dampers in accordance with the manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

D. Protect dampers from damage to operating linkages and blades.

E. Do not install wet or water-damaged materials.

1.8 WARRANTY

A. Refer to Division 01 requirements.

B. Manufacturer Warranty: Supply the manufacturer's standard warranty against defects in product workmanship and materials. Provide five-year manufacturer warranty for turning vanes, dampers, access doors, and other air duct accessories. Complete forms in the Owner's name and register with the manufacturer.

C. Installer Warranty: Provide one-year warranty for turning vanes, dampers, access doors, and other air duct accessories commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with the installer.

D. Warranty periods shall begin from the Date of Substantial Completion.

E. Correct defective work within a five year period after Substantial Completion.

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 (DCS) "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.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: Meets or exceeds the thickness of G60 coated sheet steel.

2. Exposed-Surface Finish: Mill phosphatized.

B. Aluminum Sheets: Comply with ASTM B209/B209M, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

C. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.

D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and steel ducts.

E. 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 AIR TURNING DEVICES/EXTRACTORS

A. Manufacturers:

1. Krueger-HVAC, Division of Air System Components: www.krueger-hvac.com/#sle.

2. Titus HVAC, a brand of Johnson Controls: www.titus-hvac.com/#sle.

3. Substitutions: Refer to Division 01 requirements.

B. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.4 BACKDRAFT DAMPERS - METAL

A. Manufacturers:

1. Air Balance Inc.; a division of Mestek, Inc.

2. American Warming and Ventilating, a brand of Mestek, Inc: www.awv.com/#sle.

3. Cesco Products; a division of Mestek, Inc.

4. Greenheck Fan Corporation.

5. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.

6. Nailor Industries, Inc: www.nailor.com/#sle.

7. Ruskin Company: www.ruskin.com/#sle.

8. Tamco.

9. United Enertech: www.unitedenertech.com/#sle.

10. Vent Products Company, Inc.

11. Substitutions: Refer to Division 01 requirements.

B. Maximum leakage through the exterior walls of any accessory shall be 6 cfm per 100 square feet of surface area at 2 in. w. c. test pressure.

C. All shafts penetrating ductwork walls shall have seals.

D. Description: Gravity balanced with adjustable weights.

E. Maximum Air Velocity: Not less than 2000 fpm.

F. Maximum System Pressure: Not less than 2-inch wg for low-pressure applications. Not less than 3-inch wg for medium-pressure applications. Refer to the drawing for classifications.

G. Lower limit of adjustability: adjustable to 0.02-inches wg or smaller.

H. Frame: Hat-shaped, 0.063-inch-thick extruded aluminum with welded corners.

I. Blades: Multiple single-piece blades, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.

J. Blade Action: Parallel or opposed blade.

K. Blade Seals: Extruded vinyl, mechanically locked or Neoprene, mechanically locked.

L. Blade Axles:

1. Material: Nonferrous metal, Stainless steel, Nonmetallic, or Aluminum.

2. Diameter: 0.20 inch.

M. Tie Bars and Brackets: Aluminum.

N. Return Spring: If provided, to be adjustable tension.

O. Bearings: synthetic pivot bushings.

P. Accessories:

1. Adjustment device to permit setting for various differential static pressures.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Material: Aluminum.
6. Screen Type and mesh size to comply with code.
7. 90-degree stops.

2.5 DUCT ACCESS DOORS

A. Manufacturers:

1. Greenheck; CAD.
2. Lloyd Industries, Inc: www.firedamper.com/#sle.
3. Nailor Industries, Inc; 08SC, 0890, and 0895: www.nailor.com/#sle.
4. Ruskin Company, a brand of Johnson Controls; AD-1275 and ADH-22: www.ruskin.com/#sle.
5. Substitutions: Refer to Division 01 requirements.

B. Fabrication: Rigid and close fitting of minimum gauge and material matching ductwork with quick-fastening locking devices. For insulated ducts, install minimum 1-inch thick insulation with sheet metal cover.

1. Less Than 12 inches Square: Secure with sash locks.
2. Up to 18 inches Square: Provide two hinges and two sash locks.
3. Larger Sizes: Provide an additional hinge.

C. Access doors with sheet metal screw fasteners are not acceptable.

2.6 PLENUM DUCT ACCESS DOORS

A. Manufacturers:

1. Nailor Industries, Inc; 0840-6, 0850-2L/R, and 0900-20855-2L/R: www.nailor.com/#sle.

2. Ruskin Company, a brand of Johnson Controls; ADH: www.ruskin.com/#sle.

3. Substitutions: Refer to Division 01 requirements.

B. Provide double wall insulated door complete with insulation to match the system properties.

C. Provide a viewing glass.

2.7 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.8 FLEXIBLE DUCT CONNECTORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz/sq yd.
   a. Net Fabric Width: Approximately 2 inches wide.

2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.

C. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

D. Maximum Installed Length: 14 inch.

2.9 VOLUME CONTROL DAMPERS

A. Manufacturers:

1. Air Balance Inc.; a division of Mestek, Inc.

2. Greenheck.

3. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.

4. McGill AirFlow LLC.

5. Nailor Industries, Inc: www.nailor.com/#sle.

6. Ruskin Company, a brand of Johnson Controls: www.ruskin.com/#sle.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Maximum leakage through the frame or exterior walls of manual volume dampers shall be 2 cfm per each 6-inches of damper frame height at 10 in. w. c. pressure.

D. All shafts penetrating ductwork walls shall have seals or bearings.

E. Dampers located above gypsum ceilings to include a remote, cable operated, extender. Cable access can be located in an air device or at ceiling or wall termination point.

F. Performance:

1. Comply with AMCA 500-D testing for damper rating.

2. Maximum velocity rating of 3000 fpm or greater.

3. Temperature range 0F or lower to 180°F or higher.

4. Damper to be capable of closing completely, and when closed leakage rate shall be AMCA Class II or better.

5. Pressure rating to be a minimum of 3 in.w.g.

G. Construction:

1. Linkage shall be concealed out of the airstream and within the damper frame.

2. Dampers shall bear AMCA's Certified Ratings Seal for both air performance and air leakage.

3. Dampers shall be suitable for horizontal or vertical applications (installations).

H. Splitter Dampers:

1. Material: Same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.

2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.

I. Single Blade Dampers:

1. Fabricate for duct sizes up to 6 by 30 inch.

2. Blade: 24 gauge, 0.0239 inch, minimum.

3. Ratings:
   a. Rectangular Size: Damper widths from 5 inches (127 mm) to 36 inches (914 mm) as scheduled or required.
   b. Round Size: Damper widths from 4 inches (102 mm) to 20inches (508 mm) as scheduled or required.
   c. Velocity: Damper shall have a maximum velocity rating of 1500 fpm (366 m/min) for a 36 inches (914 mm) blade.
   d. Temperature: Damper shall be rated for -50 degrees F to +250 degrees F (-46 degrees C to +121 degrees C).

4. Construction:
   a. Frame: 20 gauge (1 mm) galvanized steel, 3 inches (76 mm) deep.
   b. Blades:
      1) Style: Single skin, 20 gauge (1 mm) galvanized steel with center V groove for reinforcement.
      2) Orientation: Horizontal.
      3) Width: Maximum of 8 inches (203 mm).
   c. Bearings: Corrosion-resistant, molded synthetic sleeve type turning in an extruded hole in the damper frame.
   d. Axles: 3/8 inch (9.5 mm) square plated steel extending beyond the frame.
   e. Mounting: Vertical.
   f. Finish: Mill galvanized.

5. Accessories
   a. Include locking device to hold single-blade dampers in a fixed position without vibration.
   b. Actuator:
      1) Manual: Hand quadrant.
      2) Mounting: External.

J. Multi-Blade Damper: Fabricate of Opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

1. Blade: 18 gauge, 0.0478 inch, minimum.

2. Large dampers comprised of multiple sections – all dampers with maximum width or maximum height greater than that listed by damper manufacturer, or larger than 48” wide, or taller than 72” in height, shall be built of equal smaller sections and factory assembled with jackshaft. Provide additional bracing to support the damper at a minimum of every 72”.

3. Jackshaft:
   a. Size: minimum 0.5-inch (13-mm) diameter.
   b. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
   c. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

K. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

L. Quadrants:

1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.

2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

3. Where rod lengths exceed 30 inches provide regulator at both ends.

2.10 LOW LEAKAGE (CLASS 1A) CONTROL DAMPERS

A. Manufacturers:

1. Air Balance Inc.; a division of Mestek, Inc.

2. Greenheck; HBT and HBTR.

3. McGill AirFlow LLC.

4. Nailor Industries, Inc: www.nailor.com/#sle.

5. Ruskin Company; CD50: www.ruskin.com/#sle.

6. United Enertech: www.unitedenertech.com/#sle.

7. Substitutions: Refer to Division 01 requirements.

B. Maximum Leakage Allowed: 3 cfm/sf at 1 inch wg or 5% .

C. Frame:

1. Material: 20-gauge galvanized steel.

2. Free-area: Single cross section.

3. Blanked-off: Split frame into two free-area sections to allow a smaller free-area to be used for a minimum airflow intake or exhaust application and secondary free-area fully blanked-off.

D. Blade:

1. Type: Single-blade rectangle shape.

2. Operation: Opposed type.

3. Maximum Individual Blade Height: 8 inches.

4. Material: 12-gauge galvanized steel.

5. Authority: Opposed type, 5 to 50 percent (typically 10 percent).

E. All shafts penetrating ductwork walls shall have seals or bearings.

F. Insulation: Water-resistant sound absorbing material.

G. Temperature Service Range: Minus 25 to 185 degrees F.

H. Damper Actuators, Factory installed.

1. Motor: Maintenance-free brushless DC powered, selectable clock wise (CW) counter-clock wise (CCW) direction, 60 second stroke, and adjustable mechanical end stops within 95-degree stroke range.

2. Actuator Type: Modulated operation using incoming input signal with electronic overload protection, double-insulated electrical protection, and fail-safe control using spring-return mechanism.

3. Position Feedback: Auxiliary SPST open/close status switch signals wired into transmitter-controller.

4. Flexible conduit with interface cables prewired into transmitter-controller to receive matching output signal and matching power feed.

2.11 MISCELLANEOUS PRODUCTS

A. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.

1. Thickness: 2 mils.

2. High tack water based adhesive.

3. UV stable light blue color.

4. Elongation Before Break: 325 percent, minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect areas to receive dampers. Notify the Engineer of conditions that would adversely affect the installation or subsequent utilization of the dampers. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.3 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 23 3100 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

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. Provide duct access doors for inspection and cleaning filters, automatic motorized dampers, fans, and elsewhere as indicated. Provide minimum 8 by 8 inch size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch 6 by 6 inch for balancing dampers only. Review locations prior to fabrication.

1. Install duct access doors on sides or bottom of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

2. Omit for electric heaters.

3. Upstream from duct filters.

4. At outdoor air intake and exhaust air outlet louvers and all plenums.

5. At drain pans and seals.

6. Downstream from manual volume dampers, motorized control dampers, backdraft dampers, and equipment.

7. Adjacent to and close enough to fire or combination fire/smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or combination fire/smoke dampers shall be pressure relief type access doors.

8. At each change in direction and at maximum 50-foot (15-m) spacing.

9. Upstream and Downstream from turning vanes.

10. Control devices requiring inspection.

11. Elsewhere as indicated.

E. All access doors serving non-life safety dampers shall swing outward.

F. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 8 inches.

2. Two-Hand Access: 12 by 12 inches.

3. Head and Hand Access: 18 by 12 inches.

4. Head and Shoulders Access: 24 by 24 inches.

5. Body Access: 24 by 24 inches.

6. Body plus Ladder Access: 24 by 24 inches.

G. Provide duct test holes where indicated and required for testing and balancing purposes.

H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

J. For fans developing static pressures of 3.0 inches and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.

K. Do not compress or stretch the damper frame into the duct or opening.

L. Handle the damper using a sleeve or a frame. Do not lift the damper using blades, actuator, or jackshaft.

M. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

N. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum two duct widths from duct take-off.

O. Use splitter dampers only where indicated.

P. Install manual volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.

2. Install aluminum volume dampers in aluminum ducts.

3. Install stainless steel volume dampers in stainless steel ducts.

Q. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

R. Remote Balancing Dampers:

1. Install dampers at locations as indicated on the drawings.

2. Install dampers round and free from racking. DO NOT compress or stretch damper sleeve or frame into the duct or opening.

3. Handle dampers using the frame or sleeve. Do not lift or move damper using blades, actuator, or cable system.

4. Install cable assembly in concealed ceiling space with the control housing end flush and square to the finished ceiling line or on the wall.

5. Properly support cable sleeve to prevent twisting or bending.

6. DO NOT cover damper operator with insulation or other material that may interfere with the proper operation of the assembly.

7. Dampers with operating control through the ceiling will not require ceiling access panels.

S. Set dampers to fully open position before testing, adjusting, and balancing.

T. Connect ducts to duct silencers with flexible duct connectors.

U. Install flexible connectors at building expansion joints. Select connectors with sufficient length and movement capacity to compensate for the expansion joint movement.

3.4 IDENTIFICATION

A. Unit information labels and stickers shall never be painted over or covered in any way.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify the full range of movement.

2. Inspect locations of access doors and verify that purpose of access door can be performed.

3. Operate fire, smoke, and combination fire and smoke dampers to verify the full range of movement and verify that the proper heat-response device is installed.

4. Inspect turning vanes for proper and secure installation.

5. Operate remote damper operators to verify the full range of movement of the operator and damper.

END OF SECTION 23 3300

SECTION 23 3423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cabinet exhaust fans.

B. Ceiling exhaust fans.

C. Inline centrifugal fans and blowers.

D. High Volume Low Speed Fans

1.2 RELATED REQUIREMENTS

A. Section 23 0513 - Common Motor Requirements for HVAC Equipment.

B. Section 23 3100 - HVAC Ducts and Casings.

C. Section 23 3300 - Air Duct Accessories: Backdraft dampers.

D. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.

C. AMCA 99 - Standards Handbook; 2025.

D. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

E. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

1.4 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.5 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.

1. All Fans (Supply, Return and Exhaust fans): Submit sound power levels in octave bands from 63 Hz through 8000 Hz inclusive for the operating conditions specified. Data shall be obtained in accordance with AMCA 300-85 or more recent. If fans are variable speed, provide sound power level data for maximum rpm and also at 80% and 60% of maximum rpm. Provide discharge, inlet and case-radiated octave band sound power data for all fans.

2. Submit a performance curve for each fan showing the operating point for which the acoustical data has been provided.

3. Dampers, including housings, linkages, and operators.

4. Roof curbs.

5. Fan speed controllers.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

1.6 CLOSEOUT SUBMITTALS

A. Manufacturer's Instructions: Indicate installation instructions.

B. Operations and Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1. Start-up Report.

2. Equipment and Systems Performance Test Report

3. Commissioning Report.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Refer to Divison 01 requirements for additional provisions.

2. Extra Fan Belts: One set for each individual belt driven fan.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with documented experience.

1. For each product specified, provide components by the same manufacturer throughout.

2. The manufacturing company shall have local representation to provide continuing support for each fan.

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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1. UL Standards: Power ventilators shall comply with UL 705.

2. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

E. The contractor shall be responsible for any and all costs associated with any and all changes resulting from the use of a supplier other than the one used as the "basis of design".

1.8 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 FIELD CONDITIONS

A. Permanent ventilators may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.

1.10 COMMISSIONING

1.11 WARRANTY

A. Refer to Division 01 requirements.

B. High Volume Low Speed Fans: Non-prorated manufacturer's full replacement warranty for product and components defects in materials and workmanship, as follows:

1. Hub and airfoils: Lifetime

2. Motor, drive and controller: 10 year for factory installation, 5 year for non-factory installation.

3. Labor: 5 year.

C. Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with the manufacturer.

D. Warranty periods shall begin from Date of Substantial Completion.

E. Correct defective work within a five year period after Substantial Completion.

PART 2 - PRODUCTS

2.1 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: Comply with AMCA 204.

B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.

C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.

D. Fabrication: Comply with AMCA 99.

E. UL Compliance: UL 705, listed, labeled, designed, manufactured, and tested.

F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.2 SELECTION CRITERIA

A. Provide electronic selection with accurate site elevation.

B. Fans with greater than fractional horsepower motors shall be selected to operate no faster than 80 percent of their maximum speed.

C. Drives: Direct Drive, unless noted otherwise.

D. Motors:

1. All Single Phase motors under 1 HP shall be electrically commutated (EC).

2. All Three Phase motors shall be Permanent Split Capacitor (PSC).

2.3 CABINET EXHAUST FANS

A. Manufacturers:

1. ACME.

2. Greenheck Fan Corporation; SQ: www.greenheck.com/#sle.

3. Loren Cook Company: www.lorencook.com/#sle.

4. Substitutions: Refer to Division 01 requirements.

B. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resiliently mounted motor, gravity backdraft damper in discharge.

C. Disconnect Switch: Cord and plug-in housing for thermal overload protected motor and wall mounted switch.

D. Grille: Molded white plastic.

E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is reached with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.4 INLINE CENTRIFUGAL FANS AND BLOWERS

A. Manufacturers:

1. ACME.

2. Greenheck Fan Corporation; SQ: www.greenheck.com/#sle.

3. Loren Cook Company; DB: www.lorencook.com/#sle.

4. Substitutions: Refer to Division 01 requirements.

B. Centrifugal Fan Unit: direct driven.

C. Housing: galvanized steel housing lined with acoustic insulation, resilient mounted motor, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting, gravity backdraft damper in discharge.

D. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

E. Backward Inclined Blower: (large fans: 0.75" ESP & greater, greater than 1 HP)

1. Direct-driven, resiliently-mounted electrically-commutated motor, heavy duty ball bearings, powder-coated steel housing for outdoor service, and removable service panels.

2. Accessories: Provide external vibration isolator spring and filter section.

F. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm gets reached with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.

G. Accessories:

1. Where indicated to be provided, Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

2. Companion Flanges: For inlet and outlet duct connections.

3. Where indicated to be provided, Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

4. Where indicated to be provided, motor to be EC type.

2.5 HIGH VOLUME LOW SPEED FANS

A. Manufacturers:

1. Big Ass Fan

2. Greenheck Fan Corporation: www.greenheck.com/#sle.

B. General:

1. The entire fan assembly shall be ETL-certified and built pursuant to the construction guidelines set forth by UL standard 507 and CSA standard 22.2. No. 113.

2. Fan Characteristics: The fan shall be designed to move an effective amount of air for cooling and destratification of conditioned commercial applications over an extended life. The fan components shall be designed specifically for high volume, low speed fans to ensure lower operational noise. Sound levels from the fan operating at maximum speed measured in a laboratory setting shall not exceed 40 dBA. Actual results of sound measurements in the field may vary due to sound reflective surfaces and environmental conditions.

3. Color: Custom, as selected by the Architect and/or Owner.

C. Controls:

1. The fan controller shall be incorporated into the fan assembly and housed in an enclosure independent of the motor to prevent overheating or electrical interference. The fan controller shall be factory programmed to minimize starting and braking torques.

D. Airfoil System:

1. The fan shall be equipped with six (6) high volume, low speed airfoils of precision extruded aluminum alloy. Each airfoil shall be of the high-performance TEC design. The airfoils shall be connected to the hub and interlocked with six (6) stainless steel retainers and two (2) high strength locking bolts per airfoil.

2. The airfoils shall be powder coated as specified by the Architect or Owner.

3. The fan shall be equipped with six (6) TEC winglets designed to redirect outward airflow downward, thereby enhancing efficiency. The winglets shall be

die cast aluminum and shall be attached at the tip of each airfoil. The standard color of the winglets shall be black.

4. The fan shall be equipped with six (6) airfoil trim inserts that nest between the hub and the inner edge of each airfoil. The trim inserts shall provide a cleaner fit between the airfoils and the hub to help reduce drag, turbulence, and noise. The standard color of the trim inserts shall be black.

E. Motor:

1. The fan motor shall be a permanent magnet brushless motor rated for continuous operation at maximum speed with the capability of modulating the fan speed from 0–100% without the use of a gearbox or other mechanical means of control. The motor shall operate from any voltage ranging from 100–240 VAC, single phase, and 50/60Hz, without requiring adapters or customer selection. The motor shall be a non-ventilated, heat sink design with the capability of continuous operation in -40°F to 131°F (-40°C to 55°C) ambient conditions.

F. Mounting System:

1. The fan mounting system shall be designed for quick and secure installation from a variety of structural supports. All components in the mounting system shall be of welded construction and made from A36 steel no less than 3/16” (0.5 cm) thick. The mounting system shall be powder coated for appearance and resistance to corrosion. All mounting bolts shall be SAE Grade 8 or equivalent.

G. Hub:

1. The fan hub shall be a single precision permanent mold casting of aluminum alloy for high strength and light weight. The hub shall be precision machined to achieve a well-balanced and solid rotating assembly.

2. The hub shall incorporate six (6) safety pins made of aluminum that shall restrain the hub/airfoil assembly in case of a shaft failure. The safety pins shall be attached to the body of the hub by means of high strength bolts.

H. Safety Cables:

1. The fan shall be equipped with upper and lower safety cables. The upper safety cable shall provide an additional means of securing the fan assembly to the building structure. The lower safety cable shall provide an additional means of securing the motor unit to the mounting system. Both safety cables

shall be 3/16” (0.5 cm) diameter and fabricated out of 7 x 19 stranded galvanized steel. The end loops shall be secured with swaged Nicopress® sleeves, pre-loaded and tested to 3,200 lbf.

I. Wall Control:

1. The fan shall be equipped with a remote wall control providing control of all fan functions. The wall control shall be capable of mounting to a standard electrical box by means of an included mounting plate.

2. The wall controller shall be equipped with a 1.8” (4.6 cm) TFT-LCD screen and user interface for controlling the fan’s direction, operation, and speed.

3. Communication with the fan drive and controller shall be by a standard, commercially available CAT-5 (or higher) Ethernet cable that is field installed and provided by the installer. A 5 ft (1.5 m) patch cable shall be provided to test and verify communication signals locally prior to connecting the remote connection cable.

4. The wall control shall be equipped with a simple diagnostic program to identify faults in the system. Provisions shall be made for retrieving fan operation and diagnostic data (fault messages) through the remote wall control.

J. Guy Wires:

1. Guy wires shall be included for installations with extension tubes 4 ft (1.2 m) or longer to limit the potential for lateral movement.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install power ventilators level and plumb.

C. Equipment Mounting:

1. Comply with requirements for vibration isolation control devices specified in 23 0548 - Vibration and Seismic Controls for HVAC.

2. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

3. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch (25 mm).

Vibration-control devices are specified in Section 23 0548 - Vibration and Seismic Controls for HVAC.

4. Install units with clearances for service and maintenance.

D. Label units according to requirements specified in Section 23 0553.

E. Duct Accessories Mounting:

1. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 3300 - Air Duct Accessories.

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26.

D. Connect wiring according to Division 26.

3.3 IDENTIFICATION

A. Unit information labels and stickers shall never be painted over or covered in any way.

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.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 Testing, Adjusting, and Balancing for testing, adjusting, and balancing procedures.

C. Replace fan and motor pulleys as required to achieve design airflow.

D. Lubricate bearings.

3.6 SCHEDULES

A. Refer to the drawings.

END OF SECTION 23 3423

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SECTION 23 8126.13 - SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Air-source heat pumps.

B. Indoor air handling (fan and coil) units for ducted systems.

C. Controls.

1.2 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping: Includes indoor coil condensate drain.

B. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections and installation and wiring of thermostats and other controls components.

1.3 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2026.

B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.

C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Addendum (2026).

D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.

F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2027.

G. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.4 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

D. Design Data: Indicate refrigerant pipe sizing.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

B. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

1. Start-up Report.

2. Equipment and Systems Performance Test Report

C. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

D. Project Record Documents: Record actual locations of components and connections.

E. Documentation of all refrigerant activity (including disposal) shall be submitted to the Owner's HVAC manager. Forms and instructions are available from the Owner's HVAC manager and supervisors.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1. For each product specified, provide components by the same manufacturer throughout.

2. The manufacturing company shall have local representation to provide continuing support for each split system.

B. Installer Qualifications: Company specializing in performing the work of this section with documented experience and approved by manufacturer.

1. Properly certified technicians shall perform all work and shall have proof of certification with them at all times when they are on the job site.

2. Documentation for all technician certifications shall be filed with the Owner's HVAC manager.

C. The contractor shall be responsible for any and all costs associated with any and all changes resulting from the use of a supplier or alternate manufacturer other than the one used as the "basis of design". Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.

1.7 CERTIFICATIONS/REGULATORY REQUIREMENTS

A. The system components shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

C. The units shall be rated in accordance with AHRI 210/240 and bear the AHRI Certification label.

D. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to product and manufacturing quality and environmental management and protection set by the International Standard Organization (ISO).

E. All refrigerant work (including disposal) shall comply with EPA Section 608 regulations.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

B. Store in manufacturer's unopened packaging.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

D. Protect Indoor coil until finished floor is installed.

E. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.9 WARRANTY

A. Refer to Division 01 requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Daikin;

B. Mitsubishi;

C. Trane Inc: www.trane.com/#sle.

D. York International Corporation / Johnson Controls: www.york.com/#sle.

E. Substitutions: Refer to Division 01 requirements.

2.2 SYSTEM DESIGN

A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.

1. Heating and Cooling: Air-source electric heat pump located in outdoor unit with evaporator.

2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.

B. Performance Requirements: See Drawings for additional requirements.

C. Electrical Characteristics:

1. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 26 0583.

2.3 INDOOR AIR HANDLING UNITS FOR DUCTLESS SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, fan motor, evaporator coil, electronic modulating linear expansion device, and controls; wired for single power connection with control transformer.

1. Location: Ceiling.

2. Cabinet: Galvanized steel.
   a. Finish: White.
   b. Multi-directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining are required.

3. Filter: return air with washable, antioxidant pre-filter and a pleated anti-allergy enzyme filter.

4. Performance:
   a. As recommended by the manufacturer to match the outdoor system as a pair.

B. Evaporator Coils: Copper tube with smooth aluminum plate fin assembly, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.

1. Construction and Ratings: Factory pressure tested in accordance with AHRI 210/240 and UL 207.

2. The tubing shall have inner groves for high efficiency heat exchange.

3. All tube joints shall be brazed with silver alloy.

C. Electrical:

1. The system shall be equipped with a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire, 14 gauge AWG connections plus ground.

2. The indoor unit shall not have any supplemental electrical heat elements.

D. Quality Assurance: Factory run tested.

E. Mounting:

1. Ceiling Cassette Units: Provide hardware to support the unit from the structure .

F. Accessories:

1. Integral Condensate Pump:

2.4 SINGLE-ZONE OUTDOOR UNITS FOR DUCTLESS UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.

1. Comply with AHRI 210/240.

2. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 700.

3. Refrigerant: R-32 or R-454B.

4. Cabinet: Galvanized steel Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.

5. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL 207.

B. Compressor: single speed 3600 rpm, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, high pressure control, motor overload protection, service valves, or drier. Provide time delay control to prevent short cycling and rapid speed changes.

1. Compressor Motor: Direct Current (DC) type equipped with a factory-supplied and installed inverter drive package.

2. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, and intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used.

3. Filters, sight glasses, and traps shall not be used, and no additional refrigerant oil shall be required.

4. The outdoor unit shall have an accumulator and a high-pressure safety switch.

C. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

1. Condenser Fans: Direct-drive propeller type.
   a. 1-2.5 ton units shall be furnished with a single fan.

2. Condenser Fan Motor: Enclosed, 1-phase type, direct current (DC) motor, with permanently lubricated bearings.
   a. The fan motor shall be mounted and isolated for quiet operation.

D. Coil: Air-cooled, aluminum plate fins bonded to copper tubes.

1. The coil shall be protected with an integral metal guard.

2. Refrigerant flow from the outdoor unit shall be regulated by means of an electronically controlled, precision, linear expansion valve.

3. All refrigerant connections between outdoor and indoor units shall be flare type.

E. Electrical:

1. 208/230 VAC, 1-Phase, 60 HZ.

2. The outdoor unit shall be controlled by microprocessors located in the indoor unit and the outdoor unit. A 12 to 24 volt DC data stream shall communicate between the units, providing all necessary information for full function control.

F. Accessories: Filter drier, high-pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).

1. Provide thermostatic expansion valves with TXV metering device.

2. Provide heat pump reversing valves.

3. Provide with a manufacturer supplied 20 gauge hot dipped galvanized wind baffle. The wind baffle shall allow for continuous cooling to 0°F DB without any additional modifications to the unit.

G. Operating Controls:

1. Control by room thermostat to maintain room temperature setting.

2. Low Ambient Kit: Provide a refrigerant pressure switch to cycle the condenser fan on when the condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.

2.5 CONTROLS

A. Units shall have a conventional thermostat interface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that proper power supply is available and in correct location.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.

B. Install in accordance with NFPA 90A and NFPA 90B.

C. Install refrigeration systems in accordance with ASHRAE Std 15.

D. Mounting:

1. Mechanical Contractor shall furnish and install all supplementary steel, framing members, beam clamps, and hanger rods, etc., as required to properly support units.

2. Ensure all units are plumb and level.

3. Outdoor Units: Provide units on a concrete housekeeping pad with fixed neoprene pads.

4. Refer to the floor plans for locations.

E. Split systems shall be properly evacuated to remove air and moisture. All systems shall be evacuated as per the manufacturer’s specifications.

F. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.

3.3 FIELD QUALITY CONTROL

A. Panels on the outdoor unit shall be scratch-free at system startup. If a scratch occurs, the salt spray protection is compromised, and the panel should be replaced immediately.

B. Final refrigerant line connections at the equipment shall be tested for leaks with a standing pressure test before insulating, evacuating, and charging. The final connections shall hold a nitrogen charge for 24 hours. The nitrogen charge shall not exceed the manufacturer’s test pressure rating.

C. Verify that a standing pressure test of all refrigerant piping is complete and passed while the lines are fully accessible and before the equipment is connected.

D. Once the test is completed successfully, the lines may be insulated, and you may proceed with evacuation and charging.

3.4 CLEANING

A. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with the manufacturer’s touch-up paint.

3.5 SCHEDULE

A. Refer to the drawings.

END OF SECTION 23 8126.13

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SECTION 23 8200 - CONVECTION HEATING AND COOLING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Gas-Fired Infra-Red Tube Heaters.

B. Electric Unit Heaters.

C. Electric Wall Heaters.

1.2 RELATED REQUIREMENTS

A. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections. Installation of room thermostats. Electrical supply to units.

1.3 REFERENCE STANDARDS

A. Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

B. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).

C. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.

1.4 CONSTRUCTION SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide typical catalog of information including arrangements.

C. Shop Drawings:

1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.

2. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

3. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap

strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturer's Instructions: Indicate installation instructions and recommendations.

B. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1. Start-up Report.

2. Equipment and Systems Performance Test Report

D. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1. For each product specified, provide components by the same manufacturer throughout.

2. The manufacturing company shall have local representation to provide continuing support for each piece of equipment.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

C. The contractor shall be responsible for any and all costs associated with any and all changes resulting from the use of a supplier other than the one used as the "basis of design".

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

B. Store in manufacturer's unopened packaging.

C. Store in clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

D. Protect the Indoor coil until the finished floor is installed.

E. Do not operate units until ductwork is clean, filters are in place, bearings are lubricated, and fan has been test run under observation.

1.8 FIELD CONDITIONS

A. Refer to Division 01 requirements.

1.9 WARRANTY

A. Refer to Division 01 for additional warranty requirements.

B. The supplier shall provide a manufacturer’s published warranty covering the heater's burner core for a period of ten (10) (ears, heat exchanger and combustion chamber tubes for a period of ten (10) years, and all components utilized in the heater control assembly and hardware for a period of two (2) years.

C. Submit the manufacturer's warranty and ensure forms have been completed in the Owner's name and registered with the manufacturer.

D. Warranty periods shall begin from the Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GAS-FIRED INFRA-RED TUBE HEATERS

A. Manufacturers:

1. Solaronics, Inc; (SUNTUBE IV): https://solaronicsusa.com/

2. Spaceray (PTS) : https://spaceray.com/

3. Modine (MRS) : https://www.modinehvac.com/

B. Description

1. Gas-fired radiant tube heaters shall be designed to satisfactorily operate at a minimum inlet pressure of: 6 inches W.C. for 40-125 MBTUH units when specified for natural gas, and at a maximum inlet pressure of 14 inches W.C.

2. Gas-fired radiant tube heaters shall be designed to operate without adjustments when burning natural gas having a heat value of 1000 BTUh per cubic foot with a specific gravity of 0.65.

C. Construction

1. The heater's controls shall be totally enclosed with a corrosion resistant housing. The controls shall be easily accessible from three sides by removing the cover. The burner core assembly shall be constructed of durable materials specially designed for high efficiency, maximum heat transfer, extremely quiet operation, and extended life.

2. The heater's combustion chamber shall be 4" O.D. 16 ga. BHT (titanium coated aluminized steel), or Aluma Therm (alnuminized titanium allow steel). Either type may be heat treated or finished with a high emissivity rated, corrosion resistant, black coating. Titanium coated aluminized steel and Aluma Therm provide excellent mechanical properties at elevated temperatures and for corrosion/oxidation resistance is coated with 8% silicon/aluminum alloy and shall meet MIL 500 hour salt spray test.

3. The heater's heat exchanger tube shall be heavy-duty 16 ga. (.065") wall thickness 4" O.D. black steel.

4. The burner tube and combustion chamber shall be joined together using a tube clamp. Clamp shall be 4" O.D. 18 ga. aluminized steel and be a minimum of 5" in length. Clamp shall draw pressure using four (4) 5/16-18 x 1-1/2" zinc plated bolts and nuts drawn up (tighted to a minimum of 12 foot-pounds of torque. Two (2) #12-14x3/4" tek screws provided to secure clamp to tube connection.

5. The heat exchanger joint connections shall be swaged, interlocking configuration; the upstream tube inserts into the next tube. These connections shall be secured by a tube clamp. Clamp shall be 4" O.D. 18 ga. aluminized steel and be a minimum of 5" in length. Clamp shall draw pressure using four (4) 5/16-18 x 1-1/2" zinc plated bolts and nuts drawn up (tightened to a minimum of 12 foot-pounds of torque.) Two (2) #12-14x3/4" tek screws provided to secure clamp to tube connection.

6. The direct spark ignitor shall be durable to resist breakage.

7. Reflectors shall be 0.025" thick - #3003H25 aluminum mill finish with a geometrically designed configuration not having less than 91.7% reflectional efficiency, shall be held by a .229" diameter nickel plated steel wire hanger. Hanger shall incorporate the geometric ability to rotate the reflector 0 to 30

degrees, in either direction from horizontal using the center of the combustion chamber or heat exchanger as the axis of rotation.

8. Each 5 or 10-foot reflector section shall have the ability to be independently rotated from all other 5 or 10-foot sections, or overlapped between 5 or 10-foot sections, or a combination of both over the entire length of the system. The heater's reflector hanging system shall be designed to permit expansion while minimizing noise and/or rattles. Reflectors shall be assembled to the heater without the use of tools.

9. Heaters shall utilize a downstream turbulator that shall be factory installed in the last 10-foot heat exchanger section, wave formed for optimal turbulation, acceleration and impingement of the products of combustion resulting in appropriate velocity pressure and momentum for maximum thermal efficiency.

10. Heaters shall be equipped with a sight glass permitting a visual inspection of the spark ignitor and burner operation from the floor.

11. Tube heaters shall be designed such that, at the customer's option, outside combustion air may be supplied withouit the use of additional supply fans.

12. Heaters shall be either directly vented outdoors with insulated flue pipe, or indirectly vented by positive air displacement of 4 CFM and one square inch of net free area per 1,000 BTUH input.

13. Heaters shall come with a 36" long stainless steel flexible gas connector.

D. Controls

1. Heater controls shall be isolated from conbustion air to prevent corrosion from wet or dirty air.

2. Heaters shall be equipped with a direct spark ignition system with three (3) trials-for-ignition. Flame sensing shall be via an independent sensing rod and circuit.

3. Power supplied to each burner shall be 120 VAC, 60 Hz. (Optional 50 Hz units available.) Maximum heater electrical current draw shall not exceed 3 amps.

4. The heater controls shall have a three (3) copper conductor electrical power cord extending a minimum of thirty-six (36) inches from the control box with a three (3) prong-plug.

5. Heater controls shall include a safety differential pressure switch, factory set (non-field adjustable), to monitor combustion airflow, so as to provide complete burner shutdown due to insufficient combustion air or flue blockage.

6. The heater's control system shall be designed to shut off the gas flow to the burner in the event either a gas supply or power supply interruption occurs.

7. Combination gas control shall have a step open feature for softer ignition. Gas valve shut-off shall be of the redundant type. 100% safety shut-off.

8. The heater shall have an 1/8" - 27 FPT externally accessible inlet gas pressure test point.

9. The heater shall automatically recycle itself after an inadvertent shutdown.

10. The heater shall have three (3) system validation lights easily visible on the bottom of the burner housing. Lights shall validate "Power On," "Air Pressure Normal," and "Operation Normal."

11. The heater's blower motor shall be thermally protected, permanently lubricated and the blower motor's impeller shall be both statically and dynamically balanced.

12. The heater's airflow control system shall provide a pre-purge prior to initiating burner operation.

13. No condensation shall form as a result of combustion in the combustion chamber or heat exchanger tubes while at operatiing temperatures.

14. Total heater shutdown shall occur in the event of circuit control lockout, including burner operation and combustion air blower. An interruption of power (reset thermostat) will restart the firing sequence.

2.2 ELECTRIC UNIT HEATERS

A. Manufacturers:

1. Berko Electric Heating.

2. Modine Manufacturing Company; HER: www.modineHVAC.com/#sle.

3. Trane Technologies; UHEC: www.trane.com/#sle.

4. Markel; 5100: https://www.markel-products.com/

B. Heating Element Assembly:

1. Thermal safety cut-out within electric terminal box with automatically reset switch located near electric terminal box.

2. Horizontal Projection Units:
   a. Steel fins copper brazed to steel sheath and epoxy sealed for moisture resistance.
   b. Nickel chromium resistance wire surrounded with magnesium oxide and sheathed in steel, spiral-finned tubes.

C. Housing:

1. Suitable for ceiling or high altitude mount using provided hardware appendages.

2. Horizontal Projection Units:
   a. Provide with threaded holes for threaded rod suspension.
   b. Provisions for access to internal components for maintenance, adjustments, and repair.

D. Air Inlets and Outlets:

1. Inlets: Provide protective grilles with fan blade guard.

2. Outlets: Provide directional louvers.

E. Fan: Factory balanced, direct drive, axial type with fan guard.

F. Motor: Totally enclosed, thermally protected, and provided with permanently lubricated bearings.

G. Controls:

1. 120-volt remote temperature sensor control.

2.3 ELECTRIC WALL HEATERS

A. Manufacturers:

1. Berko Electric Heating.

2. Markel. https://www.markel-products.com/

3. Marley Engineered Products; AWH: www.marleymep.com.

4. The Trane Company; UHAA: www.trane.com.

5. Substitutions: Refer to Division 01 requirements.

B. Assembly: UL listed and labelled assembly with terminal box and cover, and built-in controls.

C. Heating Elements: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material.

D. Cabinet: 16 gauge, 0.0478 inch (1.2 mm) steel with easily removed front panel with integral air outlet and inlet grilles.

1. Cabinets located in public areas such as stairwells and vestibules shall be tamper proof.

E. Mounting Elements: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

F. Fan: Direct drive propeller type,aluminum blades, statically and dynamically balanced, with fan guard.

G. Motor: Permanently lubricated, sleeve bearings for horizontal models, ball bearings for vertical models.

H. Control: Separate fan speed switch and thermostat heat selector switch, factory wired, with switches built-in behind cover. Provide thermal overload.

I. Electrical Characteristics:

1. Refer to Equipment Schedules.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are suitable for installation.

B. Verify that field measurements are as indicated on drawings.

C. Examine roughing-in for electric units to verify actual locations of electrical connections before beginning installation.

3.2 PREPARATION

A. Coordinate with other trades to ensure that recess or bracing in walls is constructed in locations and with dimensions required for installation of recessed or surface-mounted units.

3.3 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.

C. Do not damage equipment or finishes.

D. Units with Cooling Coils: Connect drain pan to condensate drain.

E. Electric Unit Heaters:

1. Hang unit from building structure, with 1/2" threaded rods or manufacturer recommended instructions.

2. Do not support unit from electrical conduit.

3. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

4. Provide vibration isolators to prevent transmission of vibration to building.

F. Electric Wall Heaters:

1. Install units located 18" above finished floor with heating element and enclosure horizontally centered along wall.

2. Recessed or semirecessed units:
   a. In masonry walls: Bottom of unit shall be one masonry course above floor unless noted otherwise on the drawings.
   b. In exterior walls: Insulate back of unit with asphalt-impregnated fiberboard insulation.

3. Surface-mounted units:
   a. Bottom of unit shall be at least 4 inches above floor. Provide subbase.
   b. Install with a minimum of 4 bolts into the wall.

3.4 CLEANING

A. After construction and painting is completed, clean exposed surfaces of units.

B. Vacuum clean coils and inside of units.

C. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.

D. Install new filters.

3.5 CLOSEOUT ACTIVITIES

3.6 PROTECTION

A. Provide finished cabinet units with protective covers during the balance of construction.

B. Protect installed units from subsequent construction operations.

3.7 EQUIPMENT SCHEDULES

A. Refer to the drawings.

END OF SECTION 23 8200

SECTION 26 0500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section applies to all Electrical sections.

1.2 JOB CONDITIONS

A. The Contract Documents specify the scope and arrangement of the Work and shall be followed as closely as actual conditions allow.

B. The Contractor shall give consideration to all other trades, and make arrangements to avoid conflicts and interference with other Work, new or existing. Contractor shall coordinate all components of the Work, and provide minor adjustments as required, including offsets, transitions, fittings, and accessories to meet actual conditions.

C. The Contractor shall visit the job site prior to bid date to examine the conditions under which the Work is to be performed. No extra charges shall be paid for providing of Products or furnishing of Work resulting from failure to comply with this requirement.

1.3 CONFORMANCE TO REGULATIONS

A. All Work shall conform to the regulations of the applicable federal, state, and local laws, ordinances and codes.

1.4 REGULATORY REQUIREMENTS

A. All applicable Work shall conform to the requirements of NFPA 70.

B. All Products shall be listed by the Underwriters Laboratories, Inc. (UL), and shall bear the UL label. Where UL labels are not provided from the factory, the Contractor shall be responsible for having the equipment or materials tested by a UL testing firm, acceptable to authority having jurisdiction, to determine suitability of the Product for purpose specified.

1.5 QUALITY ASSURANCE

A. Work shall meet or exceed minimum recommendations of:

1. ANSI - American National Standards Institute

2. ASTM - American Society for Testing Materials

3. AWG - American Wire Gauge

4. ETL - Electrical Testing Lab

5. EIA - Electronic Industries Association

6. IEEE - Institute of Electrical and Electronic Engineers

7. NEC - National Electrical Code, NFPA 70

8. NECA - National Electrical Contractors Association

9. NEMA - National Electrical Manufacturer's Association

10. NFPA - National Fire Protection Association

11. OSHA - Occupational Safety and Health Act

12. UL - Underwriters' Laboratories, Inc.

13. VCC - Virginia Construction Code 2021

B. Reference to the standards of any technical society, organization, or association, or to the laws, ordinances, or codes of governmental authorities shall mean the latest standard, code, or specification adopted, published, and effective on the date of Bid Opening.

C. The specifications, codes, and standards referenced in these specifications (including addenda, amendments, and errata) shall govern in all cases where references thereto are made. In case of conflict between the referenced specifications, the more stringent requirement shall govern unless otherwise permitted by the Architect/Engineer. Major conflicts shall be referred to the Architect/Engineer for resolution.

1.6 MATERIALS AND EQUIPMENT

A. Unless specifically noted otherwise, all materials and equipment furnished for permanent installation in the Work shall conform to applicable standards, be of a current design, new, unused, and undamaged.

B. Individual parts shall be manufactured to standard sizes and gauges so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate equipment shall be interchangeable.

1.7 UTILITIES AND CONNECTIONS

A. Verify location of all existing utilities before laying out and making connections. Report any inconsistencies to Architect/Engineer before commencing Work. Contractor shall be responsible for correcting any errors, and repairing or replacing all materials and equipment damaged as a result of failure to comply with this requirement.

1.8 WIRING DIAGRAMS

A. All electrical equipment shall be provided with complete wiring diagrams showing all power and control connections. The diagrams shall be legible and placed in a clear plastic pouch that is permanently affixed to the equipment.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect Products from damage, marring, and soiling.

B. Any marring of factory finishes shall be repaired or replaced as necessary to match the original factory finish.

1.10 SUBMITTALS

A. Refer to Division 01 requirements.

1.11 SUBSTITUTIONS

A. Refer to Division 01 requirements.

B. For a Product specified by naming one or more manufacturer and model, and followed with the statement “or approved equal,” the Contractor may submit a Product other than the Product specified by manufacturer and model, that Product shall be considered a Substitute Product and shall comply with the following conditions:

1. The Contractor shall verify the Substitute Product is equal or superior in all respects to the Specified Product.

2. The Contractor shall submit data on the Substitute Product in compliance with the “Submittals” paragraph herein.

3. The Contractor shall be responsible for coordinating the installation of the Substitute Product with all trades. The Contractor shall be responsible for any changes required incorporating the Substitute Product into the Work.

4. The Contractor waives all claims for additional costs related to the Substitute Product that become apparent before, during or after installation.

1.12 OPERATING AND MAINTENANCE MANUAL

A. Refer to Division 01 requirements.

B. General: The Contractor shall submit one copy of the Operation and Maintenance Manual to the Architect/Engineer for review a minimum of 60 days prior to Instruction and Training Sessions. This copy will be returned to the Contractor with Architect/Engineer's comments or approval. The Contractor shall revise and resubmit one copy of the O&M Manual as required. Instruction and Training Sessions shall begin 30 days after receipt of the approved O&M Manuals. Refer to “Instruction and Training Sessions” paragraph herein.

C. Manual: Manual file shall include 'PROJECT NAME - OPERATION AND MAINTENANCE MANUAL'; applicable volume number, and project title. Provide tabbed dividers for each Product and system. Provide a table of contents for the entire manual, located at the front.

1. Manuals shall be submitted electronically in PDF format.

D. Contents: The manual shall consist of three parts as follows:

1. Part 1: Directory listing names, addresses, and telephone numbers of Architect, Engineer, Contractor, Subcontractors, and major equipment suppliers.

2. Part 2: Operation and maintenance instructions including, but not limited to, the following:
   a. General description and specifications of each component and of each system as a whole.
   b. Manufacturer's catalog description of each component supplemented by approved equipment submittals.
   c. Installation and start-up instructions, including complete calibration procedures for each component and for system as a whole.
   d. Operating instructions including:
      1) Sequence of operation
      2) Shutdown procedure
      3) Emergency operating procedures
   e. Trouble shooting guide with service instructions
   f. Preventive maintenance schedules
   g. Parts list with names, addresses, and telephone numbers of local parts suppliers.

h. Names, addresses, and phone numbers of nearest service organizations
i. Interface requirements and capabilities.

3. Part 3: Project documents including, but not limited to, the following:
   a. Testing report(s).
   b. Certificates
   c. Copies of warranties.

E. Quality: The quality of the manual will be checked by the Architect/Engineer for accuracy, completeness and quality. Deficiencies will necessitate resubmittals by the Contractor. Refer to “Submittals” paragraph herein.

1.13 INSTRUCTION AND TRAINING SESSIONS

A. Refer to Division 01 requirements.

B. After all equipment and services are in operation and receipt of the approved Operation and Maintenance Manuals, Instruction and Training Sessions shall be conducted for representatives of the Owner.

C. Instruction Session shall be conducted during the Owner's normal working periods and at times satisfactory to the Owner. Session shall last not less than one 8-hour working day.

D. The Training Session shall address the operation and maintenance of each piece of equipment and of the system as a whole. Preventative maintenance techniques shall be included.

E. Competent, factory-trained service and operating personnel from the appropriate manufacturer(s) shall give instructions and training. The Contractor shall record the names of all personnel present at each Instruction and Training Session and shall forward a copy of the attendance log to the Architect/Engineer within seven days after each session.

1.14 RECORD DRAWINGS

A. Refer to Division 01 requirements.

1.15 WORK SEQUENCE

1.16 PROJECT/SITE CONDITIONS

A. Install Work in accordance with the Contract Documents unless prevented by Project conditions.

B. When Project/Site conditions require a revision to the Work the Contractor shall prepare drawings to show proposed revision. The drawings shall include revisions to Work specified in other Sections when applicable. Submit drawings to Architect/Engineer for review. The Contractor shall allow a minimum of three business days for the Architect/Engineer to respond to proposed revision. The Contractor shall not proceed with that portion of the Work until a response has been returned.

1.17 WARRANTIES

A. Refer to Division 01 requirements.

B. Warranty periods shall begin from Date of Substantial Completion.

1.18 CONTRACTOR COORDINATION

A. Nomenclature for final room names and numbers may vary from the construction documents. Final names and numbers used in the shop drawings shall be coordinated with final room names and numbers assigned by the Owner and Architect.

B. Electrical contractor shall coordinate their work with all other trades prior to fabrication of systems and commencement of installation. It shall be the responsibility of the electrical contractor to review the work of other trades (including, but not limited to civil, structural, architectural, special equipment, fire alarm, plumbing, and HVAC) as it affects their work, and as their work affects other trades, to insure that the construction documents are closely followed and conflicts are avoided. Where discrepancies arise, they shall be referred to the Architect/Engineer for resolution before proceeding with the Work.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Unless otherwise noted, install equipment in accordance with manufacturer's printed instructions for application indicated. Maintain copies of manufacturer's printed instructions at the project site.

B. Install, operate, and adjust systems in accordance with the Contract Documents.

C. Wiring, conduit, and other items associated with the electrical system shall not obstruct access to any new or existing electrical equipment and/or mechanical equipment. All electrical equipment shall be installed where it is readily accessible for servicing.

D. A Request For Information (RFI) shall be submitted to the Architect/Engineer for any portion of the Work that the Contractor determines a clarification is required. Prior to submitting a RFI the Contractor shall thoroughly research the Contract Documents to ensure information has not been overlooked. The RFI shall include references to the portion of the Contract Documents that requires a clarification. The Contractor shall allow a minimum of three business days for the Architect/Engineer to respond to the RFI. The Contractor shall not proceed with that portion of the Work until a response has been returned.

E. All Products delivered to the site(s) shall be stored in accordance with the manufacturer's printed instructions. If a manufacturer does not have printed instructions then the Product shall be adequately housed and otherwise protected against damage or corrosion. If any Product stored at the site(s) is not protected as specified herein, the Contractor shall not receive payment for that Product. That Product shall be stored by the Owner at the expense of the Contractor. Any Product damaged as a result of failure to comply with this requirement shall be replaced by the Contractor at no additional cost to the Owner.

3.2 WORKMANSHIP

A. Install Work using procedures defined in NECA Standard of Installation.

3.3 ACCESSIBILITY

A. Wiring, conduit, and other Products associated with the electrical system shall not obstruct access to any other electrical equipment, mechanical equipment, access hatches, doorways, windows, or other portions of the building and its systems. All electrical equipment shall be installed where it is readily accessible for servicing.

3.4 FIRESTOPPING

A. Refer to Division 07 requirements.

B. For all penetrations or openings in or through fire-rated assemblies including, but not limited to, walls, floors, ceilings, shafts, etc. the Contractor will provide approved UL listed "through penetration firestop" systems to ensure integrity of rated assembly. Refer to architectural drawings and details for approved options and confirm final selection with Architect/Engineer before proceeding with this portion of the Work.

3.5 FINISHES

A. Every effort has been made to coordinate the trades involved. This coordination will be the responsibility of all parties involved in both the planning and construction of the project.

B. The Contractor shall be responsible for the careful and complete coordination of all portions of the Work with that of other trades.

1. Center all applicable devices in ceiling tiles as shown and where appropriate.

2. Hang all devices independent of ceiling system.

3. Devices and device plates shall be grouped as shown on the electrical drawings.

4. All applicable devices shall be flush with finished surfaces.

3.6 INSPECTIONS AND TESTS

A. Only persons trained and familiar with this work shall be used for testing and adjusting.

B. See individual Division 26 sections for testing requirements.

C. Documentation:

1. All tests specified shall be completely documented indicating time of day, date, temperature and all pertinent test information.

2. All required documentation of readings indicated above shall be submitted to the Architect/Engineer prior to, and as one of the prerequisites for, final acceptance of the project.

D. All equipment to conduct the tests shall be furnished at the Contractor's expense.

E. Make corrections and adjustments and repeat tests until performance requirements have been met. Submit written reports to Owner.

F. Submit certificate of final inspection and approval from authority having jurisdiction to Architect/Engineer.

G. Architect/Engineer's Right to Retesting:

1. Should the Contractor refuse or neglect to make any tests necessary to demonstrate the integrity of the completed system, the Architect/Engineer may retain the services of an outside consultant to make such tests and perform necessary corrections and adjustments.

2. The costs for such tests and adjustments shall be deducted from amounts owing to the Contractor and shall not be borne by the Owner or Architect/Engineer.

3.7 CLEANING THE INSTALLATION

A. After the equipment, wiring, and conduit has been proven operational, carefully clean all interiors of cabinets and external parts of each piece of equipment, thoroughly removing all traces of dirt, oil, grease, and other foreign substances or objects.

END OF SECTION 26 0500

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SECTION 26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single conductor building wire.

B. Metal-clad cable.

C. Wiring connectors.

D. Electrical tape.

E. Heat shrink tubing.

F. Oxide inhibiting compound.

G. Wire pulling lubricant.

1.2 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2024).

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).

E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2024.

F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2020.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

H. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable; 2018.

I. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.

J. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.

M. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.

N. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.

O. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

P. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.

Q. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

R. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.

2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.

3. Notify A/E of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

A. Refer to Division 01.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Field Quality Control Test Reports.

D. Project Record Documents: Record actual installed circuiting arrangements.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.7 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify A/E and obtain direction before proceeding with work.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Service entrance cable is not permitted.

F. Armored cable is not permitted.

G. Metal-clad cable is permitted only as follows:

1. Where not otherwise restricted, may be used:
   a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
      1) Maximum Length: 6 feet.

H. Manufactured wiring systems are not permitted.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Provide new conductors and cables manufactured not more than 2 years prior to installation.

D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

E. Comply with NEMA WC 70.

F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

G. Conductors for Grounding and Bonding: Also comply with Section 26 0526.

H. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

I. Conductor Material:

1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.

2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.

3. Tinned Copper Conductors: Comply with ASTM B33.

J. Minimum Conductor Size:

1. Branch Circuits: 12 AWG.
   a. Exceptions:
      1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
      2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.

2. Control Circuits: 14 AWG.

K. Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.

2. Color Coding Method: Integrally colored insulation.
   a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.

3. Color Code:
   a. 208Y/120 V, 3 Phase, 4 Wire System:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral/Grounded: White.
   b. Equipment Ground, All Systems: Green.
   c. For control circuits, comply with manufacturer's recommended color code.

2.3 SINGLE CONDUCTOR BUILDING WIRE

A. Description: Single conductor insulated wire.

B. Conductor Stranding:

1. Feeders and Branch Circuits:

a. Size 10 AWG and Smaller: Solid.
b. Size 8 AWG and Larger: Stranded.

C. Insulation Voltage Rating: 600 V.

D. Insulation:

1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.

2.4 METAL-CLAD CABLE

A. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

B. Conductor Stranding:

1. Size 10 AWG and Smaller: Solid.

2. Size 8 AWG and Larger: Stranded.

C. Insulation Voltage Rating: 600 V.

D. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

E. Provide oversized neutral conductors.

F. Grounding: Full-size integral equipment grounding conductor.

G. Armor: Aluminum or steel, interlocked tape.

H. Provide PVC jacket applied over cable armor.

2.5 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 0526.

C. Wiring Connectors for Splices and Taps:

1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.

2. Copper Conductors Size 6 AWG to #4/0 AWG: Use mechanical connectors or compression connectors.

3. Copper Conductors Size 250 KCMIL and Larger: Use compression connectors.

D. Wiring Connectors for Terminations:

1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.

2. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.

3. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.

4. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.

5. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.

6. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

H. Mechanical Connectors: Provide set-screw type.

I. Compression Connectors: Provide circumferential type or hex type crimp configuration.

J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.6 ACCESSORIES

A. Electrical Tape:

1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.

2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.

3. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.

4. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

D. Wire Pulling Lubricant:

1. Listed and labeled as complying with UL 267.

2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.

3. Suitable for use at installation temperature.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

A. Circuiting Requirements:

1. Unless dimensioned or specifically noted, circuit routing indicated is diagrammatic.

2. When circuit destination is indicated without specific routing, determine exact routing required. This includes potentially routing underground or in concrete slabs, requiring coordination prior to construction of some building components.

3. Arrange circuiting to avoid uncessecary splices. Excessive or uncessesary splices will be rejected.

4. Include circuit lengths required to install connected devices within 10 ft of location indicated.

5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.

6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
   a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
   b. Increase size of conductors as required to account for ampacity derating.
   c. Size raceways, boxes, etc. to accommodate conductors.

7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

8. Provide oversized neutral/grounded conductors where indicated.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install metal-clad cable (Type MC) in accordance with NECA 120.

E. Installation in Raceway:

1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.

2. Pull all conductors and cables together into raceway at same time.

3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.

4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.

2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

H. Terminate cables using suitable fittings.

1. Metal-Clad Cable (Type MC):

a. Use listed fittings.
b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.

I. Install conductors with a minimum of 12 inches of slack at each outlet.

J. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

M. Make wiring connections using specified wiring connectors.

1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.

2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.

3. Do not remove conductor strands to facilitate insertion into connector.

4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.

5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

N. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, heat shrink tubing, or cold shrink tubing.
   a. For taped connections, first apply adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
   b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.

2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
   a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
   b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.

3. Wet Locations: Use heat shrink tubing.

O. Insulate ends of spare conductors using vinyl insulating electrical tape.

P. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

Q. Identify conductors and cables in accordance with Section 26 0553.

R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

S. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

A. Refer to Divsion 01 for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is only required for services and feeders. The resistance test for parallel conductors listed as optional is not required.

1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 26 0519

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SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

F. Ground access wells.

1.2 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2025.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.

D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2026.

G. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify exact locations of underground metal water service pipe entrances to building.

2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.

3. Notify A/E of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.4 SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Field quality control test reports.

E. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Grounding System Resistance:

1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.

2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.

E. Grounding Electrode System:

1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
   a. Provide continuous grounding electrode conductors without splice or joint.
   b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.

2. Metal Underground Water Pipe(s):
   a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
   b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
   c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.

3. Metal In-Ground Support Structure:

a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.

4. Concrete-Encased Electrode:
   a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.

5. Ground Rod Electrode(s):
   a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
   b. Space electrodes not less than 10 feet from each other and any other ground electrode.
   c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.

6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.

7. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
   a. Ground Bar Size: 1/4" x 4" x 20" unless otherwise indicated or required.
   b. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

F. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.

2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.

3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.

4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.

6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.

7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
   a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
   b. Metal gas piping.

8. Provide bonding for interior metal air ducts.

9. Provide bonding for metal building frame.

10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.

G. Communications Systems Grounding and Bonding:

1. Provide bonding jumper in raceway from building grounding electrode system to each communications room or backboard and provide ground bar for termination.
   a. Bonding Jumper Size: As indicated.
   b. Raceway Size: 1" trade size unless otherwise indicated or required.
   c. Ground Bar Size: 1/4 x 4 x 20 inches unless otherwise indicated or required.
   d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

H. Lightning Protection Systems:

1. Do not use grounding electrode dedicated for lightning protection system for component of building grounding electrode system provided under this section.

2. Provide bonding of building grounding electrode system provided under this section and lightning protection grounding electrode system in accordance with NFPA 70 and NFPA 780.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

1. Provide products listed, classified, and labeled as suitable for the purpose intended.

2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:

1. Use insulated copper conductors unless otherwise indicated.

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.

2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.

3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
   a. Exceptions:
      1) Use exothermic welded connections for connections to metal building frame.

D. Ground Bars:

1. Description: Copper rectangular ground bars with mounting brackets and insulators.

2. Size: As indicated.

3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:

1. Comply with NEMA GR 1.

2. Material: Copper-bonded (copper-clad) steel.

3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

F. Ground Access Wells:

1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.

2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
   a. Round Wells: Not less than 8 inches in diameter.

3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.

4. Cover: Factory-identified by permanent means with word "GROUND".

G. Oxide Inhibiting Compound: Comply with Section 26 0519.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.

1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.

2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.

D. Make grounding and bonding connections using specified connectors.

1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.

2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.

3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.

4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Provide field inspection in accordance with Division 01 requirements.

B. Inspect and test in accordance with NETA ATS except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 26 0526

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SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

D. MFMA-4 - Metal Framing Standards Publication; 2004.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.

2. Coordinate work to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.

4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.

5. Notify A/E of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has cured.

1.4 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.5 QUALITY ASSURANCE

A. Maintain at project site one copy of each referenced document that prescribes execution requirements.

B. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with the following. Where requirements differ, comply with most stringent.
   a. NFPA 70.

b. Requirements of authorities having jurisdiction.

2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.

3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.

4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported with minimum safety factor of 100%. Include consideration for vibration, equipment operation, and shock loads where applicable.

5. Do not use products for applications other than as permitted by NFPA 70 and product listing.

6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
   a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
   b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
   c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
   d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.

1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.

2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

D. Metal Channel/Strut Framing Systems:

1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.

2. Comply with MFMA-4.

3. Channel Material:
   a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
   b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.

4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.

5. Minimum Channel Dimensions: 1-5/8 inch wide by 13/16 inch high.

E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

F. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.

2. Concrete: Use preset concrete inserts or expansion anchors.

3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.

4. Hollow Masonry: Use toggle bolts.

5. Hollow Stud Walls: Use toggle bolts.

6. Steel: Use beam clamps, machine bolts, or welded threaded studs.

7. Sheet Metal: Use sheet metal screws.

8. Wood: Use wood screws.

9. Plastic and lead anchors are not permitted.

10. Powder-actuated fasteners are not permitted.

11. Hammer-driven anchors and fasteners are not permitted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install hangers and supports in accordance with NECA 1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:

1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.

2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Conduit Support and Attachment: See Section 26 0533.13 for additional requirements.

I. Box Support and Attachment: See Section 26 0533.16 for additional requirements.

J. Busway Support and Attachment: See Section 26 2513 for additional requirements.

K. Interior Luminaire Support and Attachment: See Section 26 5100 for additional requirements.

L. Secure fasteners in accordance with manufacturer's recommended torque settings.

M. Remove temporary supports.

N. Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.3 FIELD QUALITY CONTROL

A. Refer to Division 01 for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 0529

SECTION 26 0533.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. Galvanized steel intermediate metal conduit (IMC).

C. Flexible metal conduit (FMC).

D. Liquidtight flexible metal conduit (LFMC).

E. Galvanized steel electrical metallic tubing (EMT).

F. Rigid polyvinyl chloride (PVC) conduit.

1.2 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2025.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.

C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2025.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.

F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

G. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.

H. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.

I. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.

J. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

K. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.

L. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

M. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

N. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

O. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

P. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.

2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.

3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.

4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.

5. NotifyA/E of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.4 SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

C. Project Record Documents: Record actual routing for conduits installed underground and conduits 2-inch (53 mm) trade size and larger.

1.5 QUALITY ASSURANCE

A. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

C. Protect PVC conduit from sunlight.

PART 2 - PRODUCTS

2.1 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:

1. Under Slab on Grade: Use rigid PVC conduit.

2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit or rigid PVC conduit.

3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), or rigid PVC conduit.

4. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), galvanized steel intermediate

metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) where emerging from underground.

5. Where rigid polyvinyl (PVC) conduit larger than 2-inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit (RMC) elbows, galvanized steel intermediate metal conduit (IMC) elbows, or concrete-encased PVC elbows for bends.

D. Embedded Within Concrete:

1. Within Slab on Grade: Not permitted.

2. Within Slab Above Ground: Not permitted.

3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).

F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).

G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT).

H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC).

I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC).

1. Locations subject to physical damage include, but are not limited to:
   a. Where exposed below 8 feet, except within electrical and communication rooms or closets.

K. Exposed, Exterior: Use intermediate metal conduit (IMC) or intermediate metal conduit (IMC).

L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC).

M. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC) or MC cable.

1. Maximum Length: 6 feet.

N. Flexible Connections to Vibrating Equipment:

1. Dry Locations: Use flexible metal conduit (FMC).

2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).

3. Maximum Length: 6 feet unless otherwise indicated.

4. Vibrating equipment includes, but is not limited to:
   a. Motors.

2.2 CONDUIT - GENERAL REQUIREMENTS

A. Comply with NFPA 70.

B. Electrical Service Conduits: See Section 26 2100 for additional requirements.

C. Fittings for Grounding and Bonding: See Section 26 0526 for additional requirements.

D. Provide conduit, fittings, supports, and accessories required for complete raceway system.

E. Provide products listed, classified, and labeled as suitable for purpose intended.

F. Minimum Conduit Size, Unless Otherwise Indicated:

1. Branch Circuits: 3/4-inch trade size.

2. Branch Circuit Homeruns: 3/4-inch trade size.

3. Control Circuits: 3/4 inch (21 mm) trade size.

4. Flexible Connections to Luminaires: 3/4 inch trade size.
   a. Exception: Where light fixtures will only accept a 1/2" whip.

5. Underground, Exterior: 1-inch trade size.

G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.

2. Material: Use steel or malleable iron.

3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.4 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.

2. Material: Use steel or malleable iron.

3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.5 FLEXIBLE METAL CONDUIT (FMC)

A. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2. Material: Use steel or malleable iron.

C. Description: Interlocked steel construction.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2. Material: Use steel or malleable iron.

C. Description: Interlocked steel construction with PVC jacket.

2.7 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2.8 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

B. Fittings:

1. Manufacturer: Same as manufacturer of conduit to be connected.

2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.9 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.

E. Conduit Mechanical Seals:

1. Listed as complying with UL 514B.

2. Specifically designed for sealing conduit openings against water, moisture, gases, and dust.

3. Suitable for sealing around conductors/cables to be installed.

F. Sealing Systems for Concrete Penetrations:

1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.

2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.

G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

H. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for conduit/duct arrangement to be installed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify routing and termination locations of conduit prior to rough-in.

E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in accordance with NECA 1.

C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.

D. Intermediate Metal Conduit (IMC): Install in accordance with NECA 101.

E. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.

F. Conduit Routing:

1. Unless dimensioned, conduit routing indicated is diagrammatic.

2. When conduit destination is indicated without specific routing, determine exact routing required.

3. Conceal conduits unless specifically indicated to be exposed.

4. Conduits in the following areas may be exposed, unless otherwise indicated:
   a. Electrical rooms.
   b. Mechanical equipment rooms.
   c. Within joists in areas with no ceiling.

5. Unless otherwise approved, do not route exposed conduits:
   a. Across floors.
   b. Across roofs.
   c. Across top of parapet walls.
   d. Across building exterior surfaces.

6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.

7. Arrange conduit to maintain adequate headroom, clearances, and access.

8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.

9. Arrange communications conduits to provide no more than 150 feet between pull points.

10. Route conduits above water and drain piping where possible.

11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.

12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.

13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
    a. Heaters.
    b. Hot water piping.
    c. Flues.

14. Group parallel conduits in same area on common rack.

G. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 0529.

2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.

4. Use of wire for support of conduits is not permitted.

5. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.

H. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.

2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.

3. Use suitable adapters where required to transition from one type of conduit to another.

4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.

5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.

6. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.

7. Secure joints and connections to provide mechanical strength and electrical continuity.

I. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.

2. Make penetrations perpendicular to surfaces unless otherwise indicated.

3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.

4. Conceal bends for conduit risers emerging above ground.

5. Provide suitable sealing system where conduits penetrate exterior wall below grade.

6. Provide metal escutcheon plates for conduit penetrations exposed to public view.

7. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07.

J. Underground Installation:

1. Provide trenching and backfilling in accordance with Division 31 requirements.

2. Minimum Cover, Unless Otherwise Indicated or Required:
   a. Underground, Exterior: 24 inches.

3. Provide underground warning tape in accordance with Section 26 0553 along entire conduit length.

K. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with DIvision 03 with minimum concrete cover of 3.5 inches on all sides unless otherwise indicated.

1. Use duct bank spacers to maintain conduit separation.

L. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:

1. Where conduits cross structural joints intended for expansion, contraction, or deflection.

2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.

M. Conduit Sealing:

1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
   a. Where conduits enter building from outside.
   b. Where service conduits enter building from underground distribution system.
   c. Where conduits enter building from underground.
   d. Where conduits may transport moisture to contact live parts.

2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
   a. Where conduits pass from outdoors into conditioned interior spaces.
   b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

N. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

O. Provide grounding and bonding; see Section 26 0526.

P. Identify conduits; see Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. See Division 01 for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.5 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 26 0533.13

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SECTION 26 0533.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Boxes and enclosures for integrated power, data, and audio/video.

D. Underground boxes/enclosures.

1.2 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. SCTE 77 - Specifications for Underground Enclosure Integrity; 2023.

H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

J. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.

K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.

4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.

5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.

6. Coordinate location of floor boxes with Architect prior to installation.

7. Coordinate the work with other trades to preserve insulation integrity.

8. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.

9. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for outlet and device boxes, junction and pull boxes, cabinets and enclosures, and underground boxes/enclosures.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Project Record Documents: Record actual locations for junction boxes, pull boxes, cabinets and enclosures, and underground boxes/enclosures.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Keys for Lockable Enclosures: Two of each different key.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 BOXES

A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.

2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.

3. Provide products listed, classified, and labeled as suitable for the purpose intended.

4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.

2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.

3. Use suitable concrete type boxes where flush-mounted in concrete.

4. Use suitable masonry type boxes where flush-mounted in masonry walls.

5. Use raised covers suitable for the type of wall construction and device configuration where required.

6. Do not use "through-wall" boxes designed for access from both sides of wall.

7. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.

8. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.

9. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.

10. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.

11. Minimum Box Size, Unless Otherwise Indicated:
    a. Wiring Devices: 4 inch square by 2-1/8 inch deep (100 by 54 mm) trade size.
    b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
    c. Ceiling Outlets: 4 inch octagonal or square by 2-1/8 inch deep (100 by 54 mm) trade size.

12. Wall Plates: Comply with Section 26 2726.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:

1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.

2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:

a. Indoor Clean, Dry Locations: Type 1, painted steel.
b. Outdoor Locations: Type 3R, painted steel.

3. Junction and Pull Boxes Larger Than 100 cubic inches:
   a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
   a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.

5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.

D. Underground Boxes/Enclosures:

1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.

2. Size: As indicated on drawings.

3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 24 inches.

4. Provide logo on cover to indicate type of service.

5. Applications:
   a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.
   b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 22 load rating.
   c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.

6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
   a. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify locations of floor boxes in work areas prior to rough-in.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

F. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

G. Box Locations:

1. Unless dimensioned, box locations indicated are approximate.

2. Provide access panels where required. Verify size and location of panels with Architect prior to roughing in equipment requiring access panel.

3. Locate boxes as required for devices installed under other sections or by others.

4. Locate boxes so that wall plates do not span different building finishes.

5. Locate boxes so that wall plates do not cross masonry joints.

6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.

7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.

8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.

9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
   a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
   b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.

10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.

11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    a. Concealed above accessible suspended ceilings.
    b. Within joists in areas with no ceiling.
    c. Electrical rooms.
    d. Mechanical equipment rooms.

H. Box Supports:

1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.

2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.

3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.

4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

I. Install boxes plumb and level.

J. Flush-Mounted Boxes:

1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.

2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.

3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

K. Install boxes as required to preserve insulation integrity.

L. Underground Boxes/Enclosures:

1. Install enclosure on gravel base, minimum 6 inches deep.

2. Flush-mount enclosures located in concrete or paved areas.

3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.

4. Provide cast-in-place concrete collar constructed in accordance with Division 03, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.

5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

M. Install firestopping to preserve fire resistance rating of partitions and other elements.

N. Close unused box openings.

O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

P. Provide grounding and bonding in accordance with Section 26 0526.

Q. Identify boxes in accordance with Section 26 0553.

3.3 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 26 0533.16

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SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Underground warning tape.

E. Floor marking tape.

F. Warning signs and labels.

G. Field-painted identification of conduit.

1.2 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2023.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2027.

E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:

1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.

2. Do not install identification products until final surface finishes and painting are complete.

1.4 SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.6 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 - PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
   a. Panelboards
      1) Identify ampere rating.
      2) Identify voltage and phase.
      3) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
      4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
      5) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
   b. Enclosed switches, circuit breakers, and motor controllers

1) Identify voltage and phase.
2) Identify power source and circuit number. Include location when not within sight of equipment.
3) Identify load(s) served. Include location when not within sight of equipment.

c. Busway
1) Identify ampere rating.
2) Identify voltage and phase.
3) Provide identification at maximum intervals of 40 feet.
4) Use identification nameplate to identify load(s) served for each plug-in unit. Include location when not within sight of equipment.

d. Electricity Meters:
1) Identify load(s) metered.

2. Service Equipment:
a. Use identification nameplate to identify each service disconnecting means.

3. Use identification label on inside of door at each fused switch to identify required NEMA fuse class and size.

4. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.

5. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".

6. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances.
a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Division 09.

7. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
a. Service equipment.

8. Arc Flash Hazard Warning Labels: Comply with Section 26 0573.

B. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.

2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
   a. At each source and load connection.
   b. Within boxes when more than one circuit is present.
   c. Within equipment enclosures when conductors and cables enter or leave the enclosure.

4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.

C. Identification for Raceways:

1. Use color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.
   1) Vinyl Color Coding Electrical Tape: Comply with Section 26 0519.
   b. Color Code:
      1) Fire Alarm System: Red.

2. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.

3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.

4. Use underground warning tape to identify underground raceways.

D. Identification for Boxes:

1. Use color coded boxes to identify systems other than normal power system.
   a. Color-Coded Boxes: Field painted in accordance with Division 09 per the following color code.

1) Fire Alarm System: Red. Label as "F/A".

b. For exposed boxes in public areas, do not color code.

2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
   a. For exposed boxes in public areas, use only identification labels.

E. Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.

2. Use identification label to identify fire alarm system devices.
   a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.

3. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
   a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.

4. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.

F. Identification for Luminaires:

1. Use permanent red dot on luminaire frame to identify luminaires served by emergency batteries/inverters.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Materials:
   a. Indoor Clean, Dry Locations: Use plastic nameplates.
   b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.

2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.

3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.

4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.

5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.

2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch by 2.5 inches.

2. Legend:
   a. System designation where applicable:
      1) Fire Alarm System: Identify with text "FIRE ALARM".
   b. Equipment designation or other approved description.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height:
   a. System Designation: 1 inch.
   b. Equipment Designation: 1/2 inch.

5. Color:
   a. Normal Power System: White text on black background.
   b. Fire Alarm System: White text on red background.

D. Format for General Information and Operating Instructions:

1. Minimum Size: 1 inch by 2.5 inches.

2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height: 1/4 inch.

5. Color: Black text on white background unless otherwise indicated.

E. Format for Receptacle Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.

2. Legend: Power source and circuit number or other designation indicated.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height: 3/16 inch.

5. Color: Black text on clear background.

F. Format for Control Device Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.

2. Legend: Load controlled or other designation indicated.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height: 3/16 inch.

5. Color: Black text on clear background.

G. Format for Fire Alarm Device Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.

2. Legend: Designation indicated and device zone or address.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height: 3/16 inch.

5. Color: Red text on white background.

2.3 WIRE AND CABLE MARKERS

A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

C. Legend: Power source and circuit number or other designation indicated.

D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

E. Minimum Text Height: 1/8 inch.

F. Color: Black text on white background unless otherwise indicated.

2.4 UNDERGROUND WARNING TAPE

A. Material: Polyethylene tape suitable for direct burial.

B. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

C. Detectable Tape for Open Trench Applications: 6 inches wide, with minimum thickness of 5 mils, 0.0005 inch; provide integral foil core or tracer wire for detection by locator.

D. Legend: Type of service, continuously repeated over full length of tape.

E. Color:

1. Buried Electrical Lines: Black text on red background.

2. Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.5 FLOOR MARKING TAPE

A. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches wide, with alternating black and white stripes.

2.6 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:

1. Materials:

a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.

2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.

3. Minimum Size: 7 by 10 inches unless otherwise indicated.

C. Warning Labels:

1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.

2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.

3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

B. Degrease and clean surfaces to receive nameplates and labels.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:

1. Surface-Mounted Equipment: Enclosure front.

2. Flush-Mounted Equipment: Inside of equipment door.

3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.

4. Branch Devices: Adjacent to device.

5. Interior Components: Legible from the point of access.

6. Conduits: Legible from the floor.

7. Boxes: Outside face of cover.

8. Conductors and Cables: Legible from the point of access.

9. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 12 inch(es) below finished grade.

G. Secure rigid signs using stainless steel screws.

H. Mark all handwritten text, where permitted, to be neat and legible.

3.3 FIELD QUALITY CONTROL

A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 26 0553

SECTION 26 0573 - POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Short-circuit study.

B. Arc flash and shock risk assessment.

1. Includes arc flash hazard warning labels.

C. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.2 REFERENCE STANDARDS

A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.

B. IEEE 141 - IEEE Recommended Practice for Electric Power Distribution for Industrial Plants; 1993 (Reaffirmed 1999).

C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001, with Errata (2003).

D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.

E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems; 2006.

F. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations; 2018, with Errata (2019).

G. NEMA MG 00001 - Motors and Generators; 2024.

H. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. NFPA 70E - Standard for Electrical Safety in the Workplace; 2027.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.

2. Notify A/E of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Pre-Study Meeting: Conduct meeting with Owner to discuss system operating modes and conditions to be considered in studies.

C. Sequencing:

1. Submit study reports prior to or concurrent with product submittals.

2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.

3. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).

1.4 SUBMITTALS

A. Refer to Division 01 requirements.

B. Study preparer's qualifications.

C. Study reports, stamped or sealed and signed by study preparer.

D. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.

E. Site-specific arc flash hazard warning labels.

F. Field quality control reports.

G. Certification that field adjustable protective devices have been set in accordance with requirements of studies.

H. Project Record Documents: Revise studies as required to reflect as-built conditions.

1. Include hard copies with operation and maintenance data submittals.

2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.5 POWER SYSTEM STUDIES

A. Scope of Studies:

1. Perform analysis of new electrical distribution system as indicated on drawings.

2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).

3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
   a. Known Operating Modes:
      1) Utility as source.

B. General Study Requirements:

1. Comply with NFPA 70.

2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C. Data Collection:

1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
   a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
      1) Obtain up-to-date information from Utility Company.
   b. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 00001 code letter designation.
   c. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
   d. Protective Devices:

1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).

e. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
f. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.

D. Short-Circuit Study:

1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.

2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
   a. Maximum utility fault currents.
   b. Maximum motor contribution.
   c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.

E. Arc Flash and Shock Risk Assessment:

1. Comply with NFPA 70E.

2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
   a. Where reasonable, study preparer may assume a maximum clearing time of two seconds in accordance with IEEE 1584, provided that the conditions are such that a worker's egress from an arc flash event would not be inhibited.

3. For equipment with main devices mounted in separate compartmentalized sections, perform calculations on both the line and load side of the main device.

4. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
   a. Maximum and minimum utility fault currents.
   b. Maximum and minimum motor contribution.
   c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

F. Study Reports:

1. General Requirements:
   a. Identify date of study and study preparer.
   b. Identify study methodology and software product(s) used.
   c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
   d. Identify base used for per unit values.
   e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
   f. Include conclusions and recommendations.

2. Short-Circuit Study:
   a. For each scenario, identify at each bus location:
      1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
      2) Fault point X/R ratio.
      3) Associated equipment short circuit current ratings.
   b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.

3. Arc Flash and Shock Risk Assessment:
   a. For the worst case for each scenario, identify at each bus location:
      1) Calculated incident energy and associated working distance.
      2) Calculated arc flash boundary.
      3) Bolted fault current.
      4) Arcing fault current.
      5) Clearing time.
      6) Arc gap distance.

b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.

1.6 QUALITY ASSURANCE

A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with experience in the preparation of studies of similar type and complexity using specified computer software.

1. Study preparer may be employed by manufacturer of electrical distribution equipment.

B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.

C. Contractor Responsibility: Provide all project-related data needed by study preparer, including equipment, wire sizes, insulation types, conduit types, and actual circuit lengths.

PART 2 - PRODUCTS

2.1 ARC FLASH HAZARD WARNING LABELS

A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.

1. Materials: Comply with Section 26 0553.

2. Minimum Size: 4 by 6 inches.

3. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
   a. Include orange header that reads "WARNING" unless otherwise indicated.
      1) Use read header that reads "DANGER" where incident energy is 40 ca/cm^2 or more.
   b. Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.
   c. Include the following information:
      1) Arc flash boundary.
      2) Available incident energy and corresponding working distance.
      3) Arc flash incident energy

4) Shock hazard
5) Nominal system voltage.
6) Limited approach boundary.
7) Restricted approach boundary.
8) Equipment identification.
9) Study preparer, report reference, and date calculations were performed.
10) Labels are to comply with current edition of NFPA 70E, NEC 110.15 and OSHA requirements. Labels to comply with ANSI Z535.

2.2 PROTECTIVE DEVICES

A. In addition to requirements specified elsewhere, provide overcurrent protective devices having ratings and settings in accordance with results of this analysis.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install arc flash warning labels in accordance with Section 26 0553.

3.2 FIELD QUALITY CONTROL

A. Provide the services of field testing agency or equipment manufacturer's representative to perform inspection, testing, and adjusting.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Adjust equipment and protective devices for compliance with studies and recommended settings.

D. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.

E. Submit detailed reports indicating inspection and testing results, and final adjusted settings.

F. Adjust installed protective devices having adjustable settings to conform to requirements determined by the coordination analysis.

G. Submit report showing final adjusted settings of all protective devices.

3.3 CLOSEOUT ACTIVITIES

A. Training: Include as part of the base bid training for Owner's personnel on electrical safety pertaining to arc flash and shock hazards.

1. Use site-specific arc flash and shock risk assessment report as training reference, supplemented with additional training materials as required.

2. Provide minimum of four hours of training.

3. Instructor: Representative of entity performing study.

4. Location: At project site.

END OF SECTION 26 0573

SECTION 26 0583 - WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical connections to equipment.

1.2 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

2. Determine connection locations and requirements.

B. Sequencing:

1. Install rough-in of electrical connections before installation of equipment is required.

2. Make electrical connections before required start-up of equipment.

1.4 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

1. Colors: Comply with NEMA WD 1.

2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Disconnect Switches: As specified in Section 26 2816.16 and in individual equipment sections.

C. Wiring Devices: As specified in Section 26 2726.

D. Flexible Conduit: As specified in Section 26 0533.13.

E. Wire and Cable: As specified in Section 26 0519.

F. Boxes: As specified in Section 26 0533.16.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 26 0583

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SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Occupancy sensors.

B. Digital wall control stations.

C. Daylighting controls.

D. Time switches.

E. In-wall interval timers.

F. Outdoor photo controls.

1.2 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

F. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.

G. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

H. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate placement of lighting control devices with millwork, furniture, equipment and other potential conflicts.

2. Coordinate placement of wall switch occupancy sensors with installed door swings.

3. Coordinate placement of occupancy sensors with millwork, furniture, equipment and other potential obstructions to motion detection coverage.

4. Coordinate placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement.

5. Coordinate lighting control device product selections with luminaire characteristics; see Section 26 5100 and lighting fixture schedule.

6. Notify A/E of conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install lighting control devices until final surface finishes and painting are complete.

1.4 SUBMITTALS

A. See Division 01 for submittal procedures and additional information.

B. Product Data: Include ratings, operating modes or sequence of functions, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.

1. Occupancy/Vacancy Sensors: Include detailed motion detection coverage range diagrams.

C. Shop Drawings:

1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.

2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.

D. Field quality control reports.

E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Operation and Maintenance Data: Include detailed information on device programming and setup.

G. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Maintain at project site one copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with documented experience.

D. Product Evaluation and Listing Organization Qualifications: Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratories (NRTL), and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Store products in clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.7 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.8 WARRANTY

A. Manufacturer Warranty: Provide manufacturer warranty for defects in material and workmanship for duration below. Complete forms in Owner's name and register with manufacturer.

1. Occupancy Sensors: 5 years.

2. Utility Grade Locking Receptacle-Mounted Outdoor Photo Controls: 5 years.

B. See Division 01 for additional requirements.

PART 2 - PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for purpose intended.

B. Unless specifically indicated as excluded, provide components necessary for complete operating system including, but not limited to, conduit, wiring, connectors, hardware, and accessories.

2.2 OCCUPANCY SENSORS

A. General Requirements:

1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.

2. Sensor Technology:
   a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using combination of both passive infrared and ultrasonic technologies.
   b. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using combination of both passive infrared and audible sound sensing technologies.

3. Provide LED to visually indicate motion detection.

4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during adjustable turn-off delay time interval.

5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.

6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.

7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.

8. Sensitivity: Field adjustable.

9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.

10. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above selected level.

11. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.

12. Load Rating for Line Voltage Occupancy Sensors: As required to control load indicated on drawings.

13. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.

B. Wall Switch Occupancy Sensors:

1. General Requirements:
   a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
   b. Unless otherwise indicated or required to control load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
   c. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
   d. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during delayed-off time interval.
   e. Finish: Color to be selected by Architect.

2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
   a. Passive Infrared/Microphonics dual technlogy is also acceptable.

C. Wall Dimmer Occupancy Sensors:

1. General Requirements:
   a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with field of view of 180

degrees, integrated dimming control capability, and no leakage current to load in off mode.

b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
c. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during delayed-off time interval.
d. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
e. Provide field adjustable dimming preset for occupied state.
f. Finish: Color to be selectedby architect.

D. Ceiling Mounted Occupancy Sensors:

1. General Requirements:
   a. Description: Low profile occupancy sensors designed for ceiling installation.
   b. Unless otherwise indicated or required to control load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
   c. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
   d. Finish: White unless otherwise indicated.

2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
   a. Extended Range Sensors: Capable of detecting motion within area of 1,200 square feet at mounting height of 9 feet, with field of view of 360 degrees.

3. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
   a. Extended Range Sensors: Capable of detecting motion within area of 1,200 square feet at mounting height of 9 feet.

E. Directional Occupancy Sensors:

1. General Requirements:
   a. Description: Occupancy sensors designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.

2. Passive Infrared (PIR) Directional Occupancy Sensors:
   a. High Bay Sensors: Capable of detecting motion within distance of 50 feet at mounting height of 30 feet.

F. Power Packs for Low-Voltage Occupancy Sensors:

1. Description: Plenum rated, self-contained low-voltage class 2 transformer and relay compatible with specified low-voltage occupancy sensors for switching of line-voltage loads.

2. Provide quantity and configuration of power and slave packs with associated wiring and accessories as required to control load indicated on drawings.

3. Input Supply Voltage: Dual rated for 120/277 V ac.

4. Load Rating: As required to control load indicated on drawings.

G. Dimming Power Packs for Low Voltage Occupancy Sensors:

1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.

2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.

3. Input Supply Voltage: Dual rated for 120/277 V ac.

4. Load Rating: As required to control the load indicated on drawings.

5. Dimming protocol: As required to control the load indicated on drawings.

H. Power Packs for receptacle control:

1. Plenum rated, self-contained relay compatible with specified lighting controls for control of indicated receptacles.

2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.

3. Input Supply Voltage: Dual rated for 120/277 V ac.

4. Load Rating: As required to control the load indicated on drawings.

I. Accessories:

1. Where indicated, provide compatible accessory wall switches for manual override control. Switches to match appearance of other lighting controls.

2.3 DIGITAL WALL CONTROL STATIONS

A. Description: Manual controls for on/off, dimming and lighting scene selection compatible with Occupancy and Photosensor control power packs allowing user override of indoor electrical lighting levels.

B. Switch Configuration: As indicated on the drawings.

C. Color: To be selected by Architect.

2.4 DAYLIGHTING CONTROLS

A. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.

B. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.

1. Sensor Type: Filtered silicon photo diode.

2. Sensor Range:
   a. Indoor Photo Sensors: 5 to 100 footcandles.

3. Finish: White unless otherwise indicated.

C. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.

2.5 TIME SWITCHES

A. Digital Electronic Time Switches:

1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.

2. Program Capability:

a. Astronomic Time Switches: Four channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.

3. Schedule Capacity: Not less than 16 programmable on/off operations.

4. Provide automatic daylight savings time and leap year compensation.

5. Provide power outage backup to retain programming and maintain clock.

6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.

7. Provide remote photocell input with light level adjustment.

8. Input Supply Voltage: As indicated on the drawings.

9. Output Switch Configuration: One DPST dry unpowered maintained contacts per channel.

10. Output Switch Contact Ratings: As required to control load indicated on drawings.

11. Provide lockable enclosure; environmental type per NEMA EN 10250 as specified for the following installation locations:
    a. Indoor clean, dry locations: Type 1.

2.6 IN-WALL INTERVAL TIMERS

A. Digital Electronic In-Wall Interval Timers:

1. Description: Factory-assembled solid state programmable controller with LCD display, suitable for mounting in standard wall box, and listed and labeled as complying with UL 916 or UL 917.

2. Program Capability: Designed to turn load off at end of preset time interval.

3. Time Interval: Field selectable range of presets available up to 12 hours.

4. Provide field selectable audible and visual indication to warn that end of interval operation is about to turn off load.

5. Provide power outage backup to retain programming and maintain clock.

6. Manual override: Capable of both turning load off and resetting timer to original preset time interval.

7. Switch Configuration: Suitable for use in either SPST or 3-way application.

8. Contact Ratings: As required to control load indicated on drawings.

2.7 OUTDOOR PHOTO CONTROLS

A. Stem-Mounted Outdoor Photo Controls:

1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.

2. Housing: Weatherproof, impact resistant polycarbonate.

3. Photo Sensor: Cadmium sulfide.

4. Provide external sliding shield for field adjustment of light level activation.

5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.

6. Voltage: As required to control load indicated on drawings.

7. Failure Mode: Fails to the on position.

8. Load Rating: As required to control load indicated on drawings.

9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

2.8 ACCESSORIES

A. Where indicated, provide compatible accessory wall switches for manual override control. Switches to match appearance of other lighting controls.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that service voltage and ratings of lighting control devices are appropriate for service voltage and load requirements at location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes as required for installation of lighting control devices; see Section 26 0533.16.

C. Maintain separation of remote-control, signaling, and power-limited circuits.

1. See manufacturer instructions and Section 26 0519 for control wiring conductors, wiring methods, and identification requirements.

D. Install lighting control devices in accordance with manufacturer's instructions.

E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

F. Install lighting control devices plumb and level, and held securely in place.

G. Where required and not furnished with lighting control device, provide wall plate; see Section 26 2726.

H. Provide required supports; see Section 26 0529.

I. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

J. Identify lighting control devices; see Section 26 0553.

K. Occupancy Sensor Locations:

1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.

2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

L. Outdoor Photo Control Locations:

1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.

2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by photo control itself.

M. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into photo control.

N. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near sensor location.

O. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

P. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

3.4 FIELD QUALITY CONTROL

A. Inspect each lighting control device for damage and defects.

B. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

C. Test time switches to verify proper operation.

D. Test outdoor photo controls to verify proper operation, including time delays where applicable.

E. Correct wiring deficiencies and replace damaged or defective conductors, cables, and lighting control devices.

3.5 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.

C. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by A/E. Record settings in written report to be included with submittals.

F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.

3.6 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of lighting control devices to A/E, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of four hours of training.

3. Instructor: Manufacturer's authorized service representative.

4. Location: At project site.

END OF SECTION 26 0923

SECTION 26 2100 - LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical service requirements.

1.2 DEFINITIONS

A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.3 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

A. No later than 4 weeks following date established in Notice to Proceed, notify Utility Company of anticipated date of service.

B. Coordination:

1. Verify the following with Utility Company representative:
    a. Utility Company requirements, including division of responsibility.
    b. Exact location and details of utility point of connection.
    c. Utility easement requirements.
    d. Utility Company charges associated with providing service.

2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.

3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company. This scope of work is soley the responsibility of the contractors to contact the Utility Company, obtain required dimensions/locations of equipment to achieve the required date of service as established by the contractor

D. Utility Company charges associated with providing permanent service to be paid by Owner.

E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.

F. Scheduling:

1. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

2. Arrange for inspections necessary to obtain Utility Company approval of installation.

3. Delays that could have been avoided through communication with the Utility will not be accepted.

1.5 SUBMITTALS

A. Project Record Documents: Record actual locations of equipment and installed service routing.

1.6 QUALITY ASSURANCE

A. Comply with the following:

1. IEEE C2 (National Electrical Safety Code).

2. NFPA 70 (National Electrical Code).

3. The requirements of the Utility Company.

4. The requirements of the local authorities having jurisdiction.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 ELECTRICAL SERVICE REQUIREMENTS

A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.

B. Electrical Service Characteristics: As indicated on drawings.

C. Utility Company: VTES.

D. Division of Responsibility:

1. Pad-Mounted Utility Transformers:
    a. Transformer Vaults and Pads: Furnished and installed by Contractor per Utility Company requirements.
    b. Transformers: Furnished and installed by Utility Company.
    c. Transformer Grounding Provisions: Furnished and installed by Contractor per Utility Company requirements.
    d. Transformer Protective Bollards: Furnished and installed by Contractor per Utility Company requirements.
    e. Primary:
        1) Trenching and Backfilling: Provided by Contractor.
        2) Conduits: Furnished and installed by Contractor.

3) Conductors: Furnished and installed by Utility Company.

f. Secondary:

1) Trenching and Backfilling: Provided by Contractor.
2) Conduits: Furnished and installed by Contractor.
3) Conductors: Furnished and installed by Contractor (Service Point at transformer).

2. Terminations at Service Point: Provided by Utility Company.

3. Metering Provisions:
   a. Meter Bases: Furnished and installed by Contractor per Utility Company requirements.
   b. Metering Transformer Cabinets: Furnished and installed by Contractor per Utility Company requirements.
   c. Metering Transformers: Furnished and installed by Utility Company.
   d. Conduits Between Metering Transformers and Meters: Furnished and installed by Contractor per Utility Company requirements.
   e. Wiring Between Metering Transformers and Meters: Furnished and installed by Utility Company.
   f. Communications Conduits for Meters: Furnished and installed by Contractor per Utility Company requirements.

E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Verify and mark locations of existing underground utilities.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions and Utility Company requirements.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required trenching and backfilling in accordance with Division 31.

E. Construct cast-in-place concrete pads for utility equipment in accordance with Utility Company requirements and Division 03.

F. Provide required protective bollards in accordance with Utility Company requirements.

G. Provide required support and attachment components in accordance with Section 26 0529.

H. Provide grounding and bonding for service entrance equipment in accordance with Section 26 0526.

I. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 0553.

3.4 PROTECTION

A. Protect installed equipment from subsequent construction operations.

END OF SECTION 26 2100

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SECTION 26 2416 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

1.2 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2025.

D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

E. NEMA PB 1 - Panelboards; 2011.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.

G. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

K. UL 67 - Panelboards; Current Edition, Including All Revisions.

L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

N. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.

4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

5. Notify A/E of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

A. See Division 01.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.

2. Include wiring diagrams showing all factory and field connections.

3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

4. Include documentation of listed series ratings upon request.

D. Field Quality Control Test Reports.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Panelboard Keys: Two of each different key.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.7 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:

1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

2. Panelboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Provide panelboards and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from a single supplier.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.

2. Ambient Temperature:
   a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

C. Short Circuit Current Rating:

1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.

D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with UL 67 temperature rise requirements.

1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.

2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1.
   b. Outdoor Locations: Type 3R.

2. Boxes: Galvanized steel unless otherwise indicated.
   a. Provide wiring gutters sized to accommodate the conductors to be installed.
   b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
   c. Provide painted steel boxes for surface-mounted panelboards where indicated or exposed to public view, finish to match fronts.

3. Fronts:
   a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
   b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
   c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.

4. Lockable Doors: All locks keyed alike unless otherwise indicated.

J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list and label panelboards as a complete assembly including surge protective device.

L. Load centers are not acceptable.

M. Provide the following features and accessories where indicated or where required to complete installation:

1. Feed-through lugs.

2. Sub-feed lugs.

2.3 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:

1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.

2. Main and Neutral Lug Type: mechanical or compression.

C. Bussing:

1. Phase and Neutral Bus Material: Copper.

2. Ground Bus Material: Copper.

D. Circuit Breakers:

1. Provide bolt-on type.

E. Enclosures:

1. Provide surface-mounted enclosures unless otherwise indicated.

2. Fronts: Provide trims to cover access to load terminals, wiring gutters, and other live parts, with exposed access to overcurrent protective device handles. Provide clear plastic circuit directory pocket on gutter trim cover.

2.4 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:

1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.

2. Main and Neutral Lug Type: mechanical or compression.

C. Bussing:

1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.

2. Phase and Neutral Bus Material: Copper.

3. Ground Bus Material: Copper.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:

1. Provide surface-mounted or flush-mounted enclosures as indicated.

2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.

3. Provide clear plastic circuit directory holder mounted on inside of door.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:

1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.

2. Interrupting Capacity:

a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.
b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

3. Conductor Terminations:
   a. Provide mechanical lugs unless otherwise indicated.
   b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
   b. Provide interchangeable trip units for circuit breaker frame sizes 225 amperes and larger or indicated.

5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.

6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

7. Provide the following circuit breaker types where indicated:
   a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
   b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
   c. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
   d. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.

8. Do not use tandem circuit breakers.

9. Do not use handle ties in lieu of multi-pole circuit breakers.

10. Provide the following features and accessories where indicated or where required to complete installation:
    a. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install panelboards plumb.

G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

I. Mount floor-mounted power distribution panelboards on 3 inch high concrete pad, 3" bigger than the equipment footprint, constructed in accordance with Section 03 3000.

J. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

K. Provide grounding and bonding in accordance with Section 26 0526.

L. Install all field-installed branch devices, components, and accessories.

M. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

N. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

O. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 0573.

P. Provide filler plates to cover unused spaces in panelboards.

Q. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:

1. Emergency and night lighting circuits.

2. Fire detection and alarm circuits.

R. Identify panelboards in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers larger than 100 amperes. Tests listed as optional are not required.

C. Test GFCI circuit breakers to verify proper operation.

D. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

E. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

3.5 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2416

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SECTION 26 2513 - LOW-VOLTAGE BUSWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Plug-in busway.

B. Plug-in units for plug-in busway.

1.2 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NECA 408 - Standard for Installing and Maintaining Busways; 2015.

C. NEMA BU 1.1 - General Instructions for Handling, Installation, Operation, and Maintenance of Busway Rated 600 Volts or Less; 2010.

D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

G. UL 857 - Busways; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the arrangement of busway with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others. Coordinate the work with other trades to avoid installation of obstructions within busway required clearances.

2. Coordinate arrangement of busway with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate the work with placement of supports, anchors, etc. required for mounting.

4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

5. Where busway extends through roof, coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.

6. Notify of any conflicts with or deviations Contract Documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene one week prior to performing field measurements for busway fabrication drawings; require attendance of all affected installers. Review proposed routing, sequence of installation, and protection requirements for installed busway.

C. Sequencing:

1. Perform field measurements prior to busway fabrication. Where necessary, perform field measurement for custom lengths after installation of adjacent sections.

1.4 SUBMITTALS

A. See Division 01.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for busway system components and accessories. Include dimensions, weight, materials, fabrication details, finishes, and service condition requirements. Indicate voltage and current ratings, short circuit current ratings, configurations, and installed features and accessories.

1. Include busway resistance, reactance, and impedance data and voltage drop ratings.

2. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

C. Shop Drawings: Include dimensioned plan views and sections indicating proposed busway routing, required clearances, and locations and details of supports, fittings, building element penetrations, and equipment connections.

D. Field Quality Control Test Reports.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Project Record Documents: Record actual routing of busway.

1. Include actual installed locations of plug-in units.

G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Hook Stick(s) for Plug-In Units With Hook Stick Operable Handles: One, with length as required for suitable operation of plug-in unit handle from floor or working platform.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section with documented experience with busway systems of similar size, type, and complexity.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store busway in accordance with manufacturer's instructions, NECA 408, and NEMA BU 1.1.

B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor busway, which is not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

1.7 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 - PRODUCTS

2.1 BUSWAY SYSTEM

A. Provide new busway system consisting of all required components, fittings, devices, supports, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Prefabricated sectionalized enclosed bus assemblies and associated fittings and devices; listed and labeled as complying with UL 857.

D. Busway General Requirements:

1. Busway Type: Totally enclosed, non-ventilated; suitable for installation in any mounting orientation the busway is designed for (e.g horizontal flatwise, horizontal edgewise, vertical) without derating.

2. Temperature Rise: Not exceeding 55 degrees C, when operating at continuous rated current in an ambient temperature of 104 degrees F.

3. Busbars and stabs to be suitably plated at all electrical contact points.

4. Busbar Insulation: NEMA Class B, rated 266 degrees F.

5. Housing: Steel or aluminum, with manufacturer's standard finish unless otherwise indicated.

6. Single-Bolt Type Joints:
   a. Use torque-indicating bolts with visual indication that proper torque has been applied.
   b. Bolts to be at ground potential to allow adjustment without requiring de-energizing of busway.
   c. Designed such that tightening of joints only requires access to one side of busway.
   d. Allows for length adjustment of plus/minus 0.125 inch.

E. Service Conditions:

1. Provide busway system and associated components suitable for operation under the following service conditions without derating:
   a. Altitude: Less than 6,600 feet.
   b. Ambient Temperature:
      1) Busway Lengths and Fittings: Between -22 degrees F and 104 degrees F.
      2) Circuit Breaker Plug-In Units: Between 32 degrees F and 104 degrees F.

2. Provide busway system and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

F. Short Circuit Current Rating:

1. Provide busway system and associated components with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.

2. Listed series ratings are not acceptable.

2.2 PLUG-IN BUSWAY

A. General Requirements:

1. Provide cover at each unused plug-in opening.

2. Provide means for mechanical support and alignment of plug-in units.

B. Plug-In Busway:

1. Voltage: 208Y/120V 3PH, 4W.

2. Ampere Rating: As indicated on the drawings.

3. Configuration: 3 phase, 4-wire (100 percent capacity neutral), with 50 percent capacity ground bus.

4. Busbar Material: Copper.

5. Plug-In Opening Spacing: 24 inches (610 mm) nominal between openings (openings on two sides).

2.3 PLUG-IN UNITS FOR PLUG-IN BUSWAY

A. Description: Plug-in units suitable for use with installed busway; types, ratings, configurations, and features as indicated on the drawings.

B. General Requirements:

1. Designed to make positive ground connection prior to phase/neutral connections when installed.

2. Where splash resistant busway is specified, provide splash resistant plug-in units with minimum IEC 60529 rating of IP 54 unless otherwise indicated.

C. Circuit Breaker Plug-In Units:

1. Provide safety interlock to prevent opening the cover with the unit in the ON position with capability of overriding interlock for testing purposes.

2. Provide mechanical interlock for plug-in units up to 250 A to prevent installation or removal with the unit in the ON position.

3. Conductor Terminations: Suitable for use with the conductors to be installed.

4. Provide insulated 100 percent capacity solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

5. Provide solidly bonded equipment ground bus with suitable lug for terminating equipment grounding conductor.

6. Provide thermal magnetic circuit breakers unless otherwise indicated.

7. Molded Case Circuit Breakers:
   a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489.
   b. Interrupting Capacity:
      1) Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
         (a) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
      2) Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
   c. Conductor Terminations:

1) Lug Material: Copper, suitable for terminating copper conductors only.

d. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of busway system components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive busway and associated supports.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Perform insulation resistance testing on individual current-carrying busway system components prior to installation in accordance with NECA 408 and NEMA BU 1.1.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install busway in accordance with NECA 1 (general workmanship), NECA 408, and NEMA BU 1.1.

C. Unless otherwise indicated, arrange busway to be parallel or perpendicular to building lines.

D. Arrange busway to provide required clearances and maintenance access.

E. Install busway plumb and level, with sections aligned and with horizontal runs at the proper elevation.

F. Unless otherwise indicated, orient horizontal plug-in busway with plug-in openings on sides (edgewise orientation).

G. Maintain proper phase sequence throughout busway system, accounting for phase transitions where applicable.

H. Provide suitable expansion fittings where busway is subject to movement, including but not limited to:

1. Where busway crosses structural joints intended for expansion.

2. Long straight busway runs in accordance with manufacturer's instructions.

I. Provide end closures at unconnected ends of busway runs.

J. Busway Support:

1. Use manufacturer's recommended hangers and supports, located at intervals complying with NFPA 70 and manufacturer's requirements. Provide required support and attachment in accordance with Section 26 0529, where not furnished by busway manufacturer.

2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

3. Provide sway bracing as indicated or as required to keep busway runs straight and prevent rotation and movement, accounting for unbalanced weight distribution of plug-in units where applicable.

K. Penetrations:

1. Provide suitable flanges where busway penetrates building elements. Use weatherproof flanges for exterior wall or roof penetrations. Seal roof penetrations as indicated or as required to preserve integrity of roofing system and maintain roof warranty.

2. Install firestopping to preserve fire resistance rating of building elements, using materials and methods specified in Section 07 8400.

3. Where busway penetrates floor, provide 4 inch high concrete curb constructed in accordance with Section 03 3000 around openings in accordance with NFPA 70.

L. Plug-In Units:

1. Install plug-in units on plug-in busway in accordance with manufacturer's instructions. Provide independent supports where recommended by manufacturer.

M. Provide grounding and bonding in accordance with Section 26 0526.

1. Where integral housing ground is utilized, verify joint covers and other components required for continuity are properly installed.

N. Identify busway in accordance with Section 26 0553.

3.4 FIELD QUALITY CONTROL

A. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.

B. Electrically isolate busway system before energizing and perform insulation resistance testing in accordance with NECA 408 and NEMA BU 1.1.

C. Perform infrared scanning of energized busway system under maximum load conditions in accordance with NECA 408.

D. Correct deficiencies and replace damaged or defective busway system components.

E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.5 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust supports as required to minimize strain on busway and associated components.

3.6 CLEANING

A. Clean dirt and debris from busway enclosure and components in accordance with manufacturer's instructions. Do not use compressed air or a blower in order to prevent debris infiltration.

B. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

A. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of four hours of training.

3. Instructor: Manufacturer's authorized representative.

4. Location: At project site.

3.8 PROTECTION

A. Protect busway system from subsequent construction operations.

END OF SECTION 26 2513

SECTION 26 2713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment for Owner electricity metering:

1. Single circuit electricity meters.

1.2 REFERENCE STANDARDS

A. ANSI C12.1 - Electric Meters - Code for Electricity Metering; 2026.

B. IEC 62053-21 - Electricity Metering Equipment - Particular Requirements - Part 21: Static Meters for AC Active Energy (Classes 0,5, 1 and 2); 2020.

C. IEC 62053-23 - Electricity Metering Equipment - Particular Requirements - Part 23: Static Meters for Reactive Energy (Classes 2 and 3); 2020.

D. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

F. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

G. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate work to provide equipment suitable for interface with electricity metering systems to be provided.

2. Coordinate the work with other installers to provide communication lines required for electricity metering system interface.

3. Notify A/E of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Conduct meeting with facility representative and other related equipment manufacturers to discuss electricity metering system interface requirements.

1.4 SUBMITTALS

A. See Division 01.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for electricity metering systems and associated components and accessories. Include ratings, configurations, standard wiring diagrams, dimensions, service condition requirements, and installed features.

C. Shop Drawings: Include system interconnection schematic diagrams showing all factory and field connections. Include requirements for interface with other systems.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Field Quality Control Test Reports.

F. Project Record Documents: Record actual installed locations of meters and final equipment settings.

G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

2. Enclosure Keys: Two of each different key.

3. See Section 26 2813 for requirements for spare fuses and spare fuse cabinets.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.7 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Electricity Meters - Other Acceptable Manufacturers:

2.2 EQUIPMENT FOR OWNER ELECTRICITY METERING

A. Provide microprocessor-based digital electricity metering systems including all instrument transformers, wiring, and connections necessary for measurements specified.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Provide electricity metering systems and associated components compatible with the equipment and associated circuits to be metered.

D. Service Conditions: Provide electricity meters suitable for operation under the service conditions at the installed location.

E. Enclosures:

1. Where not furnished by manufacturer, provide required cabinets and enclosures in accordance with Section 26 0533.16.

2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1.
   b. Outdoor Locations: Type 4X.

3. Provide lockable door(s).

4. Finish: Manufacturer's standard unless otherwise indicated.

F. Instrument Transformers:

1. Comply with IEEE C57.13, where applicable.

2. Select suitable ratio, burden, and accuracy as required for connected devices.

3. Current Transformers: Compatible with connected meters; replace meters damaged by connection of incompatible current transformers. Provide shorting terminal blocks for connection of secondaries where applicable.

4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

G. Interface with Other Work:

1. Interface with building automation system.

2.3 SINGLE CIRCUIT ELECTRICITY METERS

A. Single Circuit Electricity Meter:

1. Accuracy:
   a. Real/Active Power/Energy: Revenue grade; plus/minus 1.0 percent; complying with ANSI C12.1 and/or IEC 62053-21 Class 1.
   b. Reactive Power/Energy: Plus/minus 2.0 percent, complying with IEC 62053-23 Class 2.
   c. Voltage: Plus/minus 1 percent.
   d. Current: Plus/minus 1 percent.

2. Measured Parameters:
   a. Voltage (Volts AC); line-to-line and line-to-neutral; per phase.
   b. Current (Amps); per phase.
   c. Frequency (Hz).
   d. Real/active power (kW); per phase and total of all phases.
   e. Reactive power (kVAR); per phase and total of all phases.
   f. Apparent power (kVA); per phase and total of all phases.

g. Power factor; per phase and total of all phases.
h. Real/active energy (kWh).
i. Reactive energy (kVARh).
j. Apparent energy (kVAh).
k. Power demand; real/active, reactive, and apparent; present and maximum.

3. Data logging.
   a. Storage Capacity: 30 days of readings at 15 minute intervals.

4. Communications: Compatible with connected systems. Provide all accessories necessary for proper interface.
   a. Serial Communications: RS-485; support for BACnet MS/TP protocol.
   b. Ethernet Communications: Support for Modbus TCP and BACnet IP protocol.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of metering systems and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive meters.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Provide required support and attachment components in accordance with Section 26 0529.

D. Provide grounding and bonding in accordance with Section 26 0526.

E. Provide fuses complying with Section 26 2813 as required.

F. Identify meters and associated wiring in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. See Division 01 for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.

D. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.

E. Correct deficiencies and replace damaged or defective metering system components.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 ADJUSTING

A. Program system parameters according to requirements of Owner.

3.5 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

A. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of two hours of training.

3. Instructor: Manufacturer's authorized representative.

4. Location: At project site.

3.7 PROTECTION

A. Protect installed system components from subsequent construction operations.

END OF SECTION 26 2713

SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Receptacles.

B. Wall plates and covers.

C. Cord reels.

1.2 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.

C. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).

D. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

G. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.

H. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.

2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.

3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.

4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.

5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.

6. Notify A/E of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install wiring devices until final surface finishes and painting are complete.

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

B. Operation and Maintenance Data:

1. GFCI Receptacles: Include information on status indicators.

C. Project Record Documents: Record actual installed locations of wiring devices.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Evaluation and Listing Organization Qualifications: Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratories (NRTL), and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 - PRODUCTS

2.1 WIRING DEVICES - GENERAL REQUIREMENTS

A. Provide wiring devices suitable for intended use with ratings adequate for load served.

B. Except where explicitly permitted, substitution of combination switch-and-receptacle devices for separate switches and receptacles is not permitted.

C. Wiring Device Applications:

1. Receptacles Installed Outdoors or in Damp or Wet Locations: Use weather-resistant GFCI receptacles with weatherproof covers.

2. Provide GFCI protection for:
   a. Receptacles installed within 6 feet of sinks.
   b. Receptacles installed in kitchens.
   c. Receptacles serving electric drinking fountains.

D. Wiring Device Finishes:

1. Provide wiring device finishes as described below, unless otherwise indicated.
   a. Final selection of all device and wall plate colors shall be by the Architect.

2. Wiring Devices Installed in Finished Spaces: White with stainless steel wall plate.

3. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.

4. Wiring Devices Installed in Wet or Damp Locations: Gray with weatherproof in-use cover.

2.2 RECEPTACLES

A. Manufacturers:

B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.

2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:

1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.

2. Automatically Controlled Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.
   a. Controlled receptacles are to be a different color than standard duplexes. Color to be selected by Architect.

3. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

D. GFCI Receptacles:

1. General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
   a. Provide test and reset buttons of same color as device.

2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.

3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

E. Power Cord Reels, designated on drawings as 'CR':

1. Cord reels shall have an open housing, a minimum 18-inch primary power cord and a shock-absorbing ball stop, adjustable tension, built in ratchet locks, a swivel/pivot base and a forty-five (45) foot secondary power cord with an attached nonconductive rubber and plastic power outlet box having one (1) 20A duplex GFCI receptacle (NEMA 5-20R). The power cords shall be ‘SJTOW’ type with three (3) conductors.
   a. This Contractor shall furnish and install a NEMA 5-20R single receptacle in/on the ceiling as shown on the Drawings for plugging in the cord reels primary cord.

b. Contractor shall activate ratchet if not set by the factory.

2.3 WALL PLATES AND COVERS

A. Manufacturers:

1. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer.

B. Wall Plates: Comply with UL 514D.

1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.

2. Size: Standard.

3. Screws: Metal with slotted heads finished to match wall plate finish.

C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

D. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

E. Weatherproof Receptacle Covers for Wet or Damp Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

F. Weatherproof Switch Covers for Wet or Damp Locations: Gasketed, metallic, with externally operable actuating means and corrosion-resistant screws; listed as suitable for use in wet locations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.

1. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.

2. Where multiple wall switches or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.

3. Locate wall switches on strike side of door with edge of wall plate 3-6" inches from edge of door frame. Where locations are indicated otherwise, notify A/E to obtain direction prior to proceeding with work.

4. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions, except where prohibited by code.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V (depending on phasing, voltage can exceed 300 volts between 120V and 277V devices).

E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

F. If plate clamping terminals are not available, connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

I. Install wiring devices plumb and level with mounting yoke held rigidly in place.

J. Install wall switches with OFF position down.

K. Unless noted otherwise, install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left. Where installed in existing buildings, match existing receptacle orientations.

L. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

M. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use. This is not to be used where junction boxes were never required or installed by mistake.

N. Identify wiring devices in accordance with Section 26 0553.

3.4 FIELD QUALITY CONTROL

A. See Division 01 for additional requirements.

B. Inspect each wiring device for damage and defects.

C. Operate each wall switch with circuit energized to verify proper operation.

D. Test each receptacle to verify operation and proper polarity.

E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.6 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 26 2726

SECTION 26 2813 - FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fuses.

B. Spare fuse cabinet.

1.2 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.

D. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.

E. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
   a. Fusible Switches for Busway: See Section 26 2513.
   b. Fusible Enclosed Switches: See Section 26 2816.16.
   c. Fusible Switches for Enclosed Motor Controllers: See Section 26 2913.

2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.

3. Notify A/E of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

1. Spare Fuse Cabinet: Include dimensions.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Fuses: Three set(s) of three for each type and size installed.

2. Fuse Pullers: One set(s) compatible with each type and size installed.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with documented experience.

PART 2 - PRODUCTS

2.1 APPLICATIONS

A. Feeders:

1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.

2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

B. General Purpose Branch Circuits: Class RK1, time-delay.

C. Individual Motor Branch Circuits: Class RK1, time-delay.

2.2 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.

H. Class L Fuses: Comply with UL 248-10.

I. Provide the following accessories where indicated or where required to complete installation:

1. Fuseholders: Compatible with indicated fuses.

2. Fuse Reducers: For adapting indicated fuses to permit installation in switch designed for fuses with larger ampere ratings.

2.3 SPARE FUSE CABINET

A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.

B. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that mounting surfaces are ready to receive spare fuse cabinet.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

C. Install spare fuse cabinet in convenient location in main electrical room unless otherwise indicated.

D. Identify spare fuse cabinet in accordance with Section 26 0553.

END OF SECTION 26 2813

SECTION 26 2816.16 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Enclosed safety switches.

1.2 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

B. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Include wiring diagrams showing all factory and field connections.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

D. Project Record Documents: Record actual locations of enclosed switches.

E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.7 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 - PRODUCTS

2.1 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.

2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:

1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.

2. Minimum Ratings:
   a. Heavy Duty Single Throw Switches Protected by Class R Fuses: 200,000 rms symmetrical amperes.

G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

H. Provide with switch blade contact position that is visible when the cover is open.

I. Fuse Clips for Fusible Switches: As required to accept fuses indicated.

1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

J. Conductor Terminations: Suitable for use with the conductors to be installed.

K. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

L. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

M. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1.
   b. Outdoor Locations: Type 3R.

2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

N. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

O. Heavy Duty Switches:

1. Comply with NEMA BS 31047.

2. Conductor Terminations:
   a. Provide mechanical lugs unless otherwise indicated.
   b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
   a. Provide means for locking handle in the ON position where indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

I. Identify enclosed switches in accordance with Section 26 0553.

J. Provide arc flash warning labels in accordance with NFPA 70.

3.3 FIELD QUALITY CONTROL

A. See Division 01 for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2816.16

SECTION 26 2913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Enclosed NEMA controllers for low-voltage (600 V and less) applications:

1. Manual motor starters.

2. Motor-starting switches without overload protection.

B. Control accessories:

1. Auxiliary contacts.

2. Pilot devices.

3. Control power transformers.

1.2 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

C. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.

D. NEMA IA 10039 - Control Circuit and Pilot Devices; 2025.

E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

F. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.

2. Coordinate the work to provide motor controllers and associated overload relays suitable for use with the actual motors to be installed.

3. Coordinate the work to provide controllers and associated wiring suitable for interface with control devices to be installed.

4. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

5. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

6. Notify A/E of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

A. Refer to Division 01 requirements.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Field Quality Control Test Reports.

F. Project Record Documents: Record actual installed locations of controllers and final equipment settings.

1. Include nameplate data of actual installed motors and associated overload relay selections and settings.

G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with documented experience.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

1.7 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Provide enclosed motor controllers and associated components produced by single manufacturer and obtained from single supplier.

1. Motor-starting switches without overload protection may be produced by same manufacturer as wiring devices used for project.

2.2 ENCLOSED CONTROLLERS

A. Provide enclosed controller assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Enclosed controllers complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; ratings, configurations and features as indicated on the drawings.

D. Service Conditions:

1. Provide controllers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

E. Short Circuit Current Rating:

1. Provide controllers with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.

F. Conductor Terminations: Suitable for use with the conductors to be installed.

G. Enclosures:

1. Comply with NEMA IA 10030.

2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1 or Type 12.
   b. Outdoor Locations: Type 3R or Type 4.

3. Finish: Manufacturer's standard unless otherwise indicated.

H. Manual Motor Starters:

1. Description: NEMA ICS 2, Class A manually-operated motor controllers with overload relay(s).

2. Configuration: Non-reversing unless otherwise indicated.

3. Fractional-Horsepower Manual Motor Starters:
   a. Furnish with toggle operator.
   b. Overload Relays: Bimetallic or melting alloy thermal type.
   c. Provide means for locking operator in the OFF position.
   d. Furnish Red ON indicating light.
   e. Lockable.

I. Motor-Starting Switches: Horsepower-rated switches without overload protection; toggle operator. Lockable.

2.3 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:

1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate

data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.

2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.

3. Bimetallic Thermal Overload Relays:
   a. Interchangeable current elements/heaters.
   b. Adjustable trip; plus/minus 10 percent of nominal, minimum.
   c. Trip test function.

4. Melting Alloy Thermal Overload Relays:
   a. Interchangeable current elements/heaters.

2.4 CONTROL ACCESSORIES

A. Auxiliary Contacts:

1. Comply with NEMA IA 10039.

2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each magnetic motor starter, minimum.

B. Pilot Devices:

1. Comply with NEMA IA 10039; heavy-duty type.

2. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.

3. Indicating Lights: Push-to-test type unless otherwise indicated.

4. Provide LED lamp source for indicating lights and illuminated devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings of enclosed controllers are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed controllers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install controllers in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed controllers plumb and level.

F. Provide grounding and bonding in accordance with Section 26 0526.

G. Install all field-installed devices, components, and accessories.

H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

I. Select and install overload heater elements in motor controllers to match installed motor characteristics.

J. Identify enclosed controllers in accordance with Section 26 0553.

K. Coordinate control requirements for all controllers with equipment provided and with mechanical and controls contractors.

3.3 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Division 01 requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Motor Starters: Perform inspections and tests listed in NETA ATS, Section 7.16.1.1. Tests listed as optional are not required.

1. Verify motor-running protection.

2. Perform insulation-resistance tests on all control wiring with respect to ground.

D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1for circuit breakers larger than 100 amperes. Tests listed as optional are not required.

E. Correct deficiencies and replace damaged or defective enclosed controllers or associated components.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

3.6 PROTECTION

A. Protect installed enclosed controllers from subsequent construction operations.

END OF SECTION 26 2913

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SECTION 26 2923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Variable-frequency motor controllers for low-voltage (600 V and less) AC motor applications.

B. Overcurrent protective devices for motor controllers, including overload relays.

1.2 REFERENCE STANDARDS

A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

D. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.

E. NEMA IA 10039 - Control Circuit and Pilot Devices; 2025.

F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

G. NEMA IS 10033 - Industrial Control and Systems: Adjustable-Speed Drives; 2026.

H. IEEE 519 - Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

I. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).

J. NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems; 2023.

K. NEMA IS 10034 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems; 2022 (Reapproved 2025).

L. NEMA IS 10035 - Application Guide for AC Adjustable Speed Drive Systems; 2021 (Reaffirmed 2025).

M. NEMA MG 00001 - Motors and Generators; 2024.

N. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

O. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

P. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

Q. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

R. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.

S. UL 61800-5-1 - Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements – Electrical, Thermal, and Energy (Ed. 2); Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate work to avoid placement of ductwork, piping, equipment, and other obstructions within dedicated equipment spaces and working clearances required by NFPA 70.

2. Coordinate work to provide motor controllers suitable for use with motors.

3. Coordinate work to provide controllers and associated wiring suitable for interface with control devices.

4. Coordinate arrangement of electrical equipment with dimensions and clearance requirements.

5. Verify with manufacturer that conductor terminations are suitable for use with conductors.

6. Notify A/E of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

B. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series-rated systems.

C. Derating Calculations: Indicate ratings adjusted for applicable service conditions.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Field quality control test reports.

F. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

1. Include contact information for entity providing contract maintenance and trouble call-back service.

G. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

H. Project Record Documents: Record actual installed locations of controllers and final equipment settings.

1. Include nameplate data of actual installed motors and associated overload relay selections and settings.

I. Maintenance Materials: Furnish following for Owner's use in maintenance of project.

1. Air Filters: Two of each different type.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

1.7 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

1.8 WARRANTY

A. Provide minimum five-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

B. Warranty periods shall begin from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Provide variable-frequency motor controllers and associated components produced by single manufacturer and obtained from single supplier.

2.2 VARIABLE-FREQUENCY MOTOR CONTROLLERS

A. Provide variable-frequency motor control system consisting of required controller assemblies, operator interfaces, control power transformers, instrumentation and control wiring, sensors, accessories, system programming, etc. as necessary for complete operating system.

B. Provide products listed, classified, and labeled as suitable for purpose intended.

C. Variable-Frequency Motor Controller:

1. Configuration: Packaged controller with across-the-line bypass.

2. Rectifier/Converter: IGBT-based active front end type.

3. Control Method: Vector; open-loop, without feedback.

4. Filtering: Provide input/line reactor and output/load reactor.

D. Controller Assemblies: Comply with NEMA IS 10033, NEMA IS 10034, and NEMA ICS 61800-2; list and label as complying with UL 61800-5-1 or UL 508A as applicable.

E. Provide controllers selected for actual installed motors and coupled mechanical loads in accordance with NEMA IS 10035, NEMA MG 00001 Part 30, and recommendations of manufacturers of both controller and load, where not in conflict with specified requirements; considerations include, but are not limited to:

1. Motor type (e.g., induction, reluctance, and permanent magnet); consider NEMA MG 00001 design letter or inverter duty rating for induction motors.

2. Motor load type (e.g., constant torque, variable torque, and constant horsepower); consider duty cycle, impact loads, and high inertia loads.

3. Motor nameplate data.

4. Requirements for speed control range, speed regulation, and braking.

5. Motor suitability for bypass starting method, where applicable.

F. Devices on Load Side of Controller: Suitable for application across full controller output frequency range.

G. Operating Requirements:

1. Input Voltage Tolerance: Plus/minus 10 percent of nominal.

2. Input Frequency Tolerance: Plus/minus 5 percent of nominal.

3. Efficiency: Minimum of 96 percent at full speed and load.

4. Input Displacement Power Factor: Minimum of 0.96 throughout speed and load range.

5. Overload Rating:
   a. Variable Torque Loads: Minimum of 110 percent of nominal for 60 seconds.
   b. Constant Torque Loads: Minimum of 150 percent of nominal for 60 seconds.

H. Power Conversion System: Microprocessor-based, pulse width modulation type.

1. Diode-based, 6-pulse type unless otherwise indicated.

I. Control System:

1. Provide microprocessor-based control system for automatic control, monitoring, and protection of motors. Include sensors, wiring, and connections necessary for functions and status/alarm indications specified.

2. Provide integral operator interface for controller programming, display of status/alarm indications, fault reset, and local control functions including motor run/stop, motor forward/reverse selection, motor speed increase/decrease, and local/remote control selection.

3. Control Functions:
   a. Control Method: Selectable vector and scalar/volts per hertz unless otherwise indicated.
      1) Scalar/Volts per Hertz Control: Provide IR compensation for improved low-speed torque.
      2) Vector Control: Provide selectable autotuning function.
   b. Adjustable acceleration and deceleration time; linear and S-curve ramps; selectable coast to stop.
   c. Selectable braking control; DC injection or flux braking.
   d. Adjustable minimum/maximum speed limits.
   e. Adjustable pulse width modulation switching carrier frequency.
   f. Adjustable motor slip compensation.
   g. Selectable autorestart after noncritical fault; programmable number of time delay between restart attempts.
   h. PID Control: Provide integral PID controller employing feedback for closed-loop control where indicated or required.
   i. Selectable frequency-skipping; minimum of three independently adjustable bands.
   j. Safety Interlock: Provide permissive run safety interlock capability where indicated or required; upon activation of designated input, stop and prevent operation of motor; operational in both drive and bypass modes where applicable.

4. Status Indications:
   a. Motor run/stop status.
   b. Motor forward/reverse status.
   c. Local/remote control status.
   d. Output voltage.

e. Output current.
f. Output frequency.
g. DC bus voltage.
h. Motor speed.

5. Protective Functions/Alarm Indications:
   a. Overcurrent.
   b. Motor overload.
   c. Undervoltage.
   d. Overvoltage.
   e. Controller overtemperature.
   f. Input/output phase loss.
   g. Output short circuit protection.
   h. Output ground fault protection.

6. Inputs:
   a. Digital Input(s): Three.
   b. Analog Input(s): Two.

7. Outputs:
   a. Analog Output(s): One.
   b. Relay Output(s): Two.

8. Communications: Compatible with connected systems. Provide accessories necessary for proper interface.
   a. Drives shall be able to communicate with the Building Automation Syste.
   b. Coordinate communications requirements with Controls Contractor.

9. Features:
   a. Password-protected security access.
   b. Event log.

J. Power Conditioning/Filtering:

1. Provide DC link choke or input/line reactor for each controller unless otherwise indicated or required.

2. Reactor Impedance: 3 percent, unless otherwise indicated or required.

K. Packaged Controllers: Controllers factory-mounted in separate enclosure with externally operable disconnect and specified accessories.

1. Disconnects: Circuit breaker or disconnect switch type.

a. Disconnect Switches: Fusible type or nonfusible type with separate input fuses.
b. Provide externally operable handle with means for locking in OFF position. Provide safety interlock to prevent opening cover with disconnect in ON position with capability of overriding interlock for testing purposes.
c. Provide auxiliary interlock for disconnection of external control power sources where applicable.

2. Provide door-mounted remote operator interface.

L. Service Conditions:

1. Provide controllers and associated components suitable for operation under following service conditions without derating:
   a. Altitude: Less than 3,300 feet.
   b. Ambient Temperature: Between 32 degrees F and 104 degrees F.

2. Provide controllers and associated components suitable for operation at indicated ratings under service conditions at installed location.

M. Short Circuit Current Rating:

1. Provide controllers with listed short circuit current rating not less than available fault current at installed location as determined by short circuit study performed in accordance with Section 26 0573.

2. Provide line/input reactors where specified by manufacturer for required short circuit current rating.

3. Listed series ratings are not acceptable.

N. Conductor Terminations: Suitable for use with conductors to be installed.

O. Enclosures:

1. Comply with NEMA IA 10030.

2. NEMA EN 10250 Environment Type or Equivalent IEC 60529 Rating: Unless otherwise indicated, as specified for following installation locations:
   a. Indoor Clean, Dry Locations: Type 1 or Type 12.
   b. Outdoor Locations: Type 3R or Type 4.

3. Finish: Manufacturer's standard unless otherwise indicated.

4. Cooling: Forced air or natural convection as determined by manufacturer.

P. Interface with Other Work:

1. Provide products compatible with other systems requiring interface with controllers.

2. Interface with building automation system.

2.3 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:

1. Provide overload relays and, where applicable, associated current elements/heaters selected for actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.

2. Comply with NEMA ICS 2.

3. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.

4. Trip-free operation.

5. Visible trip indication.

6. Resettable.
   a. Employ manual reset unless otherwise indicated.
   b. Do not employ automatic reset with two-wire control.

B. Fusible Disconnect Switches:

1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA BS 31047, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated or as required.

2. Fuse Clips: As required to accept indicated fuses.

3. Provide externally operable handle with means for locking in OFF position. Provide means for locking switch cover in closed position. Provide safety interlock to prevent opening of cover with switch in ON position with capability of overriding interlock for testing purposes.

C. Circuit Breakers:

1. Motor Circuit Protectors:
   a. Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489 recognized only for use as part of listed combination motor controller with overload protection; ratings, configurations, and features as indicated or as required.
   b. Provide field-adjustable magnetic instantaneous trip setting.

2.4 ACCESSORIES

A. Auxiliary Contacts:

1. Comply with NEMA IA 10039.

2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each bypass motor starter, minimum.

B. Pilot Devices:

1. Comply with NEMA IA 10039; heavy-duty type.

2. Pushbuttons: Unless otherwise indicated, provide momentary, nonilluminated type with flush button operator; normally open or normally closed as indicated or as required.

3. Selector Switches: Unless otherwise indicated, provide maintained, nonilluminated type with knob operator; number of switch positions as indicated or as required.

4. Indicating Lights: Push-to-test type unless otherwise indicated.

5. Provide LED lamp source for indicating lights and illuminated devices.

C. Control Power Transformers:

1. Size to accommodate burden of contactor coil(s) and connected auxiliary devices, plus 25 percent spare capacity.

2. Include primary and secondary fuses.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings of controllers are consistent with indicated requirements.

C. Verify that mounting surfaces are ready to accept controllers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install controllers in accordance with NECA 1 (general workmanship).

B. Install in accordance with NEMA IS 10034 and manufacturer's instructions.

C. Do not exceed manufacturer's recommended maximum cable length between controller and motor.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install controllers plumb and level.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Install field-installed devices, components, and accessories.

I. Provide fuses complying with Section 26 2813 for fusible switches as indicated.

J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

K. Set field-adjustable settings of controllers and associated components according to installed motor requirements, in accordance with recommendations of manufacturers of controller and load.

L. Identify controllers in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Provide services of manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.17. Insulation-resistance test on control wiring listed as optional is not required.

D. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

E. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers larger than 100 amperes. Tests listed as optional are not required.

F. Test for proper interface with other systems.

G. Correct deficiencies and replace damaged or defective controllers or associated components.

H. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of controllers to Owner, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of controllers and associated devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of two hours of training.

3. Instructor: Manufacturer's authorized representative.

4. Location: At project site.

3.7 PROTECTION

A. Protect installed controllers from subsequent construction operations.

END OF SECTION 26 2923

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SECTION 26 4113 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Strike (air) terminals and interconnecting conductors.

B. Grounding and bonding for lightning protection.

1.2 REFERENCE STANDARDS

A. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2026.

B. UL 96 - Lightning Protection Components; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination with Concrete Work: Coordinate the embedding of lightning protection components in concrete.

B. Coordination with Roofing Work: Ensure adequate attachment of strike terminals and conductors without damage to roofing.

C. Preinstallation Meeting: Convene a meeting at least at least two weeks prior to commencement of any work affected by lightning protection system requirements to discuss prerequisites and coordination required by other installers; require attendance by representatives of installers whose work will be affected.

1.4 SUBMITTALS

A. Refer to Division 01 requirements.

B. Shop Drawings: Indicate location and layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.

1. Where conductors or grounds are to be embedded or concealed in other construction, submit shop drawings at least 30 days prior to start of construction.

2. If concrete-encased grounds are to be used and are not shown in Contract Documents, provide sufficient data to determine concrete encasement dimensions and location.

3. Include data on actual ground resistance determined by field measurement in accordance with NFPA 780.

4. Include engineering analysis of equalization of potential to metal bodies within the structure.

5. Include access panels, test holes, and disconnecting means for maintenance.

C. Product Data: Provide dimensions and materials of each component, indication of testing agency listing, and installation instructions.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Installation Certification: Submit copy of certification agency's approval.

F. Operation and Maintenance Data: Provide recommended inspection and testing plan, including recommended intervals, to achieve periodic maintenance as recommended in NFPA 780; provide customized plan reflecting actual installation configuration with specific installed components identified.

G. Project Record Documents: Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors in project record documents.

H. Certification: Provide master label for system and all installed elements.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in lightning protection equipment with documented experience.

B. Designer Qualifications: Person or entity, employed by installer, who specializes in lightning protection system design with documented experience.

C. Installer Qualifications: Capable of providing the specified certification of the installed system.

D. Installer Qualifications: Company specializing in lightning protection system design with documented experience.

E. Field Quality Control Testing Agency Qualifications: Firm capable of and experienced in grounding and bonding testing with documented experience and minimum of three project references.

F. Products: Listed, classified, and labeled as suitable for the purpose intended.

G. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

A. Lightning Protection System: Provide complete system complying with NFPA 780, including air terminals, bonding, interconnecting conductors and grounding electrodes.

1. Provide system that protects:
   a. The entire structure.

2. Coordinate with other grounding and bonding systems specified.

3. Determine ground resistance by field measurement.

4. Provide copper, bronze, or stainless steel components, except where aluminum is allowed by NFPA 780.

5. Provide disconnecting means and access panels or similar devices to allow complete periodic inspection and testing as described by NFPA 780 Annex D.

6. Provide system certified by Underwriters Laboratories or the Lightning Protection Institute.

B. Strike Terminals: Provide strike (air) terminals on the following:

1. Roofs.

2.2 COMPONENTS

A. All Components: Complying with applicable requirements of UL 96.

B. Strike (Air) Terminals: Copper, solid with bases suitable for roof installation/mounting.

C. Grounding Rods: Solid copper or copper-clad steel.

D. Ground Plate: Copper.

E. Conductors: Copper cable.

F. Connectors and Splicers: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated on shop drawings.

B. Coordinate work with installation of roofing and exterior and interior finishes.

3.2 INSTALLATION

A. Install in accordance with referenced system standards and as required for specified certification.

B. Connect conductors using mechanical connectors or exothermic welding process; protect adjacent construction elements and finishes from damage.

3.3 FIELD QUALITY CONTROL

A. Perform field inspection in accordance with Division 01.

B. Perform visual inspection as specified in NFPA 780 as if this were a periodic follow-up inspection.

C. Perform continuity testing as specified in NFPA 780 as if this were testing for periodic maintenance.

D. Obtain the services of the specified certification agency to provide inspection and certification of the lightning protection system, including performance of any other testing required by that agency.

END OF SECTION 26 4113

SECTION 26 4300 - SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surge protective devices for service entrance locations.

1.2 ABBREVIATIONS AND ACRONYMS

A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.

B. SPD: Surge Protective Device.

1.3 REFERENCE STANDARDS

A. MIL-STD-220 - Method of Insertion Loss Measurement; 2009c (Validated 2024).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 1283 - Standard for Electromagnetic Interference Filters; Current Edition, Including All Revisions.

G. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify A/E of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.5 SUBMITTALS

A. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

B. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.

C. Certificates: Manufacturer's documentation of listing for compliance with the following standards:

1. UL 1449.

D. Field Quality Control Test Reports.

E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.

G. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

H. Project Record Documents: Record actual connections and locations of surge protective devices.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. Manufacturer's Warranty: Provide minimum ten year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

B. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 - PRODUCTS

2.1 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.

B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mounted SPDs.

C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

D. Protected Modes:

1. Wye Systems: L-N, L-G, N-G, L-L.

E. UL 1449 Voltage Protection Ratings (VPRs):

1. 208Y/120V System Voltage: Not more than 700 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.

F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.

G. Enclosure Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:

1. Indoor clean, dry locations: Type 1.

H. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:

1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.

I. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.

1. Panelboards: See Section 26 2416.

2.2 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

A. Surge Protective Device:

1. Protection Circuits: Field-replaceable modular or non-modular.

2. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.

3. UL 1449 Nominal Discharge Current (I-n): 20 kA.

4. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.

5. EMI/RFI Filtering: Provide EMI/RFI filter to attenuate electrical noise; listed as complying with UL 1283 for Type 2 SPDs (UL 1283 listing not available for Type 1 SPDs).
   a. Noise Attenuation: Not less than 40 dB at 100 kHz using MIL-STD-220 insertion loss test method.

6. Diagnostics:
   a. Protection Status Monitoring: Provide indicator lights to report the protection for each phase.
   b. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
   c. Remote Status Monitoring: Provide Form C dry type contacts (normally open and normally closed) for remote annunciation of status.

d. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.

7. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

8. Locate surge protection at main distribution panelboard.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.

C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.

D. Verify system grounding and bonding is in accordance with Section 26 0526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.

E. Provide conductors with minimum ampacity as required by NFPA 70 and as required by NFPA 70.

F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.

G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.3 FIELD QUALITY CONTROL

A. Perform inspection, testing, and adjusting in accordance with Division 01 requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS Section 7.19.1.

D. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

3.4 CLEANING

A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 4300

SECTION 26 5100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior luminaires.

B. Exit signs.

C. Ballasts and drivers.

D. LED luminaires and drivers.

E. Accessories.

1.2 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.

B. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2024.

C. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

E. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2025.

F. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2023.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

I. UL 1598 - Luminaires; Current Edition, Including All Revisions.

J. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.

2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.

3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.

4. Notify A/E of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.4 SUBMITTALS

A. Refer to Division 01 requirements.

B. Shop Drawings:

1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

2. Provide photometric calculations where luminaires are proposed for substitution.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:
   a. Include estimated useful life, calculated based on IES LM-80 test data.
   b. Include IES LM-79 test report upon request.

D. Field quality control reports.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

G. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with documented experience.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting) and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.7 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.8 WARRANTY

A. Refer to Division 01 requirements.

B. Provide five year manufacturer warranty for all LED luminaires, including drivers.

C. Provide ten year pro-rata warranty for batteries for self-powered exit signs.

PART 2 - PRODUCTS

2.1 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

B. Substitutions: Refer to Division 01 requirements.

2.2 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Recessed Luminaires:

1. Ceiling Compatibility: Comply with NEMA LE 4.

H. LED Luminaires:

1. Components: UL 8750 recognized or listed as applicable.

2. Tested in accordance with IES LM-79 and IES LM-80.

3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.3 EXIT SIGNS

A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.

1. Number of Faces: Single- or double-face as indicated or as required for installed location.

2. Directional Arrows: As indicated or as required for installed location.

B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.

1. Self-Powered Exit Signs:

a. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
b. Battery: Sealed, maintenance-free, nickel cadmium unless otherwise indicated.
c. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
d. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.4 BALLASTS AND DRIVERS

A. Dimmable LED Drivers:

1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.

2. Control Compatibility: Fully compatible with the dimming controls to be installed.
   a. Daylighting Controls: See Section 26 0923.
   b. Lighting Controls: See Section 290923.

2.5 LED LUMINAIRES AND DRIVERS

A. General:

1. Comply with IES LM-79-08 Approved Method for measuring lumen maintenance of LED light sources.

2. Comply with IES LM-80-08 Approved Method for electrical and photometric measurement of SSL product.

3. Comply with In-Situ testing for more reliable results.

4. LED’s shall be Restriction of Hazardous Substances Directive (RoHS) compliant.

5. LED arrays shall be sealed, high performance, long life type; inimum 70% rated output at 50,000 hours.

6. LED luminaires shall deliver a minimum of 60 lumens per watt.

a. LED's shall be "Bin No. 1" quality.

7. Drivers shall be solid state and accept 120 through 277 VAC at 60 Hz input.

8. The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.

9. Luminaires shall have internal thermal protection.

10. Luminaires shall not draw power in the off state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.

11. Luminaires shall not draw power in the off state.
    a. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.

12. Color spatial uniformity shall be within 0.004 of CIE 1976 diagram.

13. Color maintenance over rated life shall be within 0.007 of CIE 1976.

14. Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management.

15. LED package(s)/module(s)/array(s) used in qualified luminaires shall deliver a minimum 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours

16. Luminaires shall be fully accessible from below ceiling plane for changing drivers, power supplies and arrays.

17. LED drivers shall include the following features unless otherwise indicated.
    a. Minimum efficiency: 85% at full load.
    b. Minimum Operating Ambient Temperature: -4 degrees F (-20 degrees C).
    c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
    d. Integral short circuit, open circuit, and overload protection.
    e. Power Factor: > 0.95.
    f. Total Harmonic Distortion: < 20%.
    g. Comply with FCC 47 CFR Part 15.

B. LED Troffers

1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.

2. Housing, LED driver, and LED module shall be products of the same manufacturer.

C. Power Supplies and Drivers

1. Power Factor: 0.90 or higher

2. Maximum driver case temperature not to exceed driver manufacturer recommended in-situ operation.

3. Output operating frequency: 60 Hz.

4. Interference: EMI and RFI compliant with FCC 47 CFR Part 15.

5. Total Harmonic Distortion Rating: 20% Maximum.

6. Meet electrical and thermal conditions as described in LM-80 Section 5.0.7.

7. Primary Current: Confirm primary current with Drawings.

8. Secondary Current: Confirm secondary current specified by individual luminaire manufacturers.

9. Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified control components.

10. Solid-state control components to be integral or external per each specified luminaire.

11. Remote control gear to be enclosed in Class 1, Class 2, or NEMA 3R enclosures as required.

2.6 ACCESSORIES

A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install products in accordance with manufacturer's instructions.

D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

G. Suspended Ceiling Mounted Luminaires:

1. Do not use ceiling tiles to bear weight of luminaires.

2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.

3. Secure surface-mounted and recessed luminaires to building structure.

4. Secure pendant-mounted luminaires to building structure.

5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.

6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.

H. Recessed Luminaires:

1. Install trims tight to mounting surface with no visible light leakage.

2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.

I. Suspended Luminaires:

1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.

2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.

3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.

4. Install canopies tight to mounting surface.

J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

K. Locate ceiling luminaires as indicated on reflected ceiling plan.

L. Install accessories furnished with each luminaire.

M. Bond products and metal accessories to branch circuit equipment grounding conductor.

N. Exit Signs:

1. Unless otherwise indicated, connect unit to unswitched powerfrom circuit indicated. Bypass local switches, contactors, or other lighting controls.

3.4 FIELD QUALITY CONTROL

A. See Division 01 for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Test self-powered exit signs and emergency lighting inverters and emergency batteries/drivers to verify proper operation upon loss of normal power supply.

E. Correct wiring deficiencies and repair or replace damaged or defective products.

3.5 ADJUSTING

A. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.6 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting) and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

3.8 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 5100

SECTION 28 3111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:

1. Section 260519 “Low-Voltage Electrical Power Conductors and Cables” for cables and conductors for fire-alarm systems.

C. The fire alarm system shall be the Code compliant and fully functional. The system and all associated operations shall be in accordance with the following:

1. The Virginia Uniform Statewide Building Code: VUSBC, 2021 Edition.

2. NFPA 72, National Fire Alarm Code, 2019 Edition

3. NFPA 70, National Electrical Code, 2020 Edition

4. Virginia Tech Design and Construction Standards – May 2023

5. Current version of the Virginia Tech Campus Fire Alarm Standards.

1.2 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.

2. Manual fire-alarm boxes.

3. System smoke detectors.

4. Heat detectors.

5. Notification appliances.

6. Remote annunciator.

7. Addressable interface device.

8. Voice evacuation system.

9. Digital alarm communicator transmitter.

B. DEFINITIONS

C. LED: Light-emitting diode.

D. NICET: National Institute for Certification in Engineering Technologies.

E. FACU: Fire-Alarm Control Unit

1.3 SUBMITTALS

A. General Submittal Requirements:

1. Shop drawing submittal shall include: Floor plans with device locations and addresses. Riser diagram including cable type and circuit layouts, battery calculations, voltage drop calculations, material list and associated product datasheets. See paragraphs below for more details. I. Resubmit if revisions are required due to comments from A/E. If the submittal, with any added notations, is satisfactory to the A/E; the A/E shall so stamp and send one copy of such documents to the Owner and University Building Official (UBO) for final review and approval. Upon receipt of comments from UBO authorities, make resubmissions if required to make clarifications or revisions to obtain approval. Any fire alarm work shall not commence until drawings are approved.

2. Indicate Project I.D. # (shown on project documents) on all shop drawings, calculations, etc.

3. Shop Drawings shall be prepared by persons with the following qualifications:
   a. Trained and certified by manufacturer in fire-alarm system design.
   b. NICET-certified fire-alarm technician, Level III minimum.

B. Product Data: For each type of product indicated. Data shall indicate the specific products, features, or functions required to meet this specification.

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.

2. Include voltage drop calculations for notification appliance circuits to assure that the system will operate per the prescribed backup time periods and under all voltage conditions per UL and NFPA Standards.

3. Include battery-size calculations.

4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

5. Include on plans, heating, ventilating, and air-conditioning ducts coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.

6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.

7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

D. Qualification Data: For qualified Installer.

E. Field quality-control reports.

F. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.

3. Record copy of site-specific software.

4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
   a. Frequency of testing of installed components.

b. Frequency of inspection of installed components.
c. Requirements and recommendations related to results of maintenance.
d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.

6. Abbreviated operating instructions for mounting at fire-alarm control unit.

7. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.

8. Record of field tests of system.

9. Operating instruction for fire-alarm control panel.

G. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On compact disk, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

5. Include shop drawings using AutoCAD 2008 showing system details including location of fire-alarm control units, all devices, circuiting and details of graphic annunciator.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system. Components shall be under the appropriate category by underwriters Laboratories, Inc. (UL), and shall bare the “UL” label.

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.

D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.5 WARRANTY PERIOD AND TESTING

A. Warranty period shall extend one (1) year beyond the substantial completion of the total project.

B. After the total completion of the project, during the one-year warranty period, two complete system tests shall be provided and included as part of the initial purchase of the system. The first test shall be done after six months from substantial completion of total project, and the second during the eleventh month of the total project. These must be scheduled through the university.

1.6 MAINTENANCE SERVICE

A. Maintenance Service Contract: Provide maintenance of fire alarm systems and equipment for a period of 12 months, using factory-authorized service representatives.

B. Basic Services: Systematic, routine maintenance visits on a quarterly basis at times scheduled with the Owner. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.

C. Additional Services: Perform services within the above 12-month period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.

D. Renewal of Maintenance Service Contract: No later than 60 days prior to the expiration of the maintenance services contract, deliver to the Owner a proposal to provide contract maintenance and repair services for an additional one-year term. Owner will be under no obligation to accept maintenance service contract renewal proposal.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.

2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.

3. Smoke Detectors, Fire Detectors, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.

4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 5 unit of each type.

5. Keys and Tools: One extra set for access to locked and tamper proofed components.

6. Audible and Visual Notification Appliances: Five of each type installed.

7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: The equipment and service described in this specification are those supplied and supported by SimplexGrinnell and represent the base bid for the equipment.

1. Subject to compliance with requirements, provide products by the following:
   a. SimplexGrinnell

2. All fire alarm equipment shall be listed as compatible with Johnson Controls.

3. System shall have the proper technology to be fully compatible with the campus fire alarm network and that each be fully integrated as a node on the same.

B. The Manufacturer shall be a nationally recognized company specializing in fire alarm and detection systems. This organization shall employ factory trained and NICET certified technicians, and shall maintain a service organization within 100 miles of this project location. The Manufacturer and service organization shall have a minimum of 10 years experience in the fire protective signaling systems industry.

2.2 SYSTEM DESCRIPTION

A. Network fire alarm control units shall include all features as described in this specification for stand-alone FACUs and shall have network communication capabilities as described herein.

1. All points monitored and controlled by a single node shall be capable of being programmed as "Public". Each point made public to the network may be programmed to be operated by any other node connected to the network.

2. Network communications shall be capable of supporting "point lists" that can be handled as though they were a single point.

B. The network shall provide a means to log into any node on the system via a laptop computer or CRT/Keyboard and have complete network access (Set Host) for diagnostics, maintenance reporting, and information gathering of all nodes in the system. Systems not meeting this requirement must provide all diagnostic tools required to support this function from selected points on the network. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.

C. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.

D. The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:

1. Fire alarm and detection operations

2. Control and monitoring of elevators, smoke control equipment, door hold-open devices, electric door looks, fire suppression systems, emergency power systems, and other equipment as indicated in the drawings and specifications.

3. One-way supervised automatic voice alarm operations.

E. The Graphics Command Center (GCC) in the Virginia Tech Police Department, as well as the two other auxiliary GCC’s, shall be reprogrammed to include information, site plans, floor plans, etc., as needed to add the new system to the network.

1. The University’s room numbering must be used to program the labels for the points in the control unit, and not the construction document numbers.

2.3 SYSTEMS OPERATIONAL DESCRIPTION

A. General: Provide a complete, non-coded, addressable/conventional, microprocessor-based fire-alarm system with addressable initiating devices, addressable notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.

B. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory. System shall be capable of storing dual configuration programs with one active and one in reserve. Panel shall be capable of full system operation during a new configuration download.

C. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.

D. Recording of Events: Record all alarm, supervisory, and trouble events by means of system printer. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout differentiates alarm signals from all other printed indications.

E. Wiring/Signal Transmission:

1. Transmission shall be hard-wired, using separate individual circuits for each zone of alarm operation as required or addressable signal transmission, dedicated to fire alarm service only.

2. System connections for initiating, signaling line circuits and notification appliance circuits shall be Class B. However, audio riser and Remote Unit Interface (RUI) circuits to remote transponders shall be Class A wiring.

3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACU. Provide a distinctive indicating audible tone and alphanumeric annunciation.

F. Remote Access:

1. FACU shall have the capability to provide Remote Access through a Dial-Up Service Modem using the public switched telephone system of a private switched telephone system.

2. A personal computer or technician's laptop, configured with terminal emulation software shall have the ability to access the FACU for diagnostics, maintenance reporting and information gathering.

3. FACU shall have the capability to provide third party access through a serial interface connection and be agency listed for specific interfaces and for the purpose.

4. FACU shall have the capability to provide remote access via an Internet/Intranet Interface. The Internet interface shall provide an alternative access to system information using the familiar interface of a standard Internet browser. A remotely located fire professional can use this access to analyze control panel status during non-alarm conditions and can also use this information to assist local fire responders during alarm conditions.

G. Network communication:

1. Network node communication shall be through a token ring configuration.

2. A single open, ground or short on the network communication loop shall not degrade network communications. Token shall be passed in opposite direction to maintain communications throughout all network nodes. At the same time the status of the communication link shall be reported.

3. If a group of nodes becomes isolated from the rest of the network due to multiple fault conditions, that group shall automatically form a sub-network with all common interaction of monitoring and control remaining intact. The network shall be notified with the exact details of the lost communications.

4. The communication method shall be NFPA 72 style 7.

H. Campus Network communication:

1. Network cabling to existing Simplex 4120 campus fire alarm network shall be six (6) single mode fibers to the nearest existing network fire alarm control panel. Fiber installation for campus network will be performed by Owner’s NI&S Group. Coordinate the necessary fiber type and work with the Owner.

2. Fire alarm control unit shall have fiber optic and copper network communications interface module for remote sire monitoring. The module shall utilize fiber termination with required connectors.

I. Required Functions: The following are required system functions and operating features:

1. Priority of Signals: Fire alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-,

and fourth-level priority respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.

2. No interfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACU after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent addressable device activations.

3. Transmission to Local Monitoring Station: Automatically route alarm, supervisory, and trouble signals to the Truesite Workstation (TSW) in the Virginia Tech Police Department, as well as two other auxiliary TSW's. All 3 TSW's must be reprogrammed to include information, site plans, floor plans, etc., as needed to add the new system to the network.

4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACU and the remote annunciator, indicating the location and type of device.

5. TSW (Truesite Workstation) Maps: After acceptance of the system by the owner, point by point graphic identification and annunciation of all initiating devices shown on floor plans shall be provided.

6. Selective Alarm: A system alarm shall include:
    a. Indication of alarm condition at the FACU and the annunciator(s).
    b. Identification of the device /zone that is the source of the alarm at the FACU and the annunciator(s).
    c. Operation of audible and visible notification devices on the entire building until silenced at FACU.
    d. Selectively closing doors normally held open by magnetic door holders on the fire floor, floor above and floor below.
    e. Unlocking electric door locks in designated egress paths.
    f. Shutting down supply and return fans serving zone where alarm is initiated.
    g. Closing smoke dampers on system serving zone where alarm is initiated.
    h. Notifying the local fire department.
    i. Initiation of elevator recall in accordance with ASME/ANSI A17.1, when specified detectors or sensors are activated.

7. Supervisory Operations: Upon activation of a supervisory device such as fire pump power failure, low air pressure switch, and tamper switch, the system shall operate as follows:
   a. Activate the system supervisory service audible signal and illuminate the LED at the control unit and the remote annunciator.
   b. Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.
   c. Record the event in the FACU historical log.
   d. Transmission of supervisory signal to remote central station.
   e. Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.

8. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible and visible alarm signals shall cease operation.

9. System Reset
   a. The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-alarming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."
   b. Should an alarm condition continue, the system will remain in an alarmed state.

10. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.

11. WALKTEST: The system shall have the capacity of 8 programmable passcode protected one-person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode of the system as follows:
   a. The city circuit connection and any suppression release circuits shall be bypassed for the testing group.
   b. Control relay functions associated to one of the 8 testing groups shall be bypassed.
   c. The control unit shall indicate a trouble condition.
   d. The alarm activation of any initiation device in the testing group shall cause the audible notification appliances assigned only to that group to sound a code to identify the device or zone.

e. The unit shall automatically reset itself after signaling is complete.
f. Any opening of an initiating or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.

J. General: Comply with UL 864, “Control Units for Fire-Protective Signaling Systems.”

K. The following FACU hardware shall be provided based on a Simplex 4100ES Platform.

1. Master controller QVGA LCD display, English User Interface with raised keys.

2. Power limited base panel with beige cabinet and door, 120VAc input power.

3. 2,000 point capacity where (1) point equals (1) monitor input or control output.

4. 2,000 points of network annunciation at FACP display when applied as a network node..

L. Manual Pull Stations based on Simplex 4099-9001:
a. Single-action mechanism initiates an alarm.
b. Station Reset: Key operated switch.
c. Integral Addressable Module: Arranged to communicate manual-station status (normal, alarm, or trouble) to the FACU.
d. All pull stations shall be equipped with alarmed, Lexan “Stopper II” covers to prevent vandalism, fabricated of clear plastic. Hinged at the top to permit lifting for access to initiate an alarm.

M. Analog Smoke Sensors based on Simplex 4098-9714 head and 4098-9792 bases: Smoke detectors shall be true alarm type.

1. Monitoring: FACU shall individually monitor sensors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.

2. Environmental Compensation: The FACU shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.

3. Programmable Sensitivity: Photoelectric Smoke Sensors shall have 7 selectable sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACU.

4. Sensitivity Testing Reports: The FACU shall provide sensor reports that meet NFPA 72 calibrated test method requirements. The reports shall be viewed on a CRT Display or printed for annual recording and logging of the calibration maintenance schedule.

5. The FACU shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to automatically indicate when a sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate if a sensor is close to a trouble reporting condition and will be indicated on the FACU as "ALMOST DIRTY." This condition provides a means to alert maintenance staff of a sensor approaching dirty without creating a trouble in the system. If this indicator is ignored and the second level is reached, a "DIRTY SENSOR" condition shall be indicated at the FACU and subsequently a system trouble is reported [to the Central Monitoring Station]. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If a "DIRTY SENSOR" is left unattended, and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control unit.

6. The FACU shall continuously perform an automatic self-test on each sensor, which will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.]

7. Multi-Sensors shall combine photoelectric smoke sensing and heat sensing technologies. An alarm shall be determined by either smoke detection, with selectable sensitivity from 0.2 to 3.7 %/ft obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.

8. Programmable bases. It shall be possible to program relay and sounder bases to operate independently of their associated sensor.

9. Magnet test activation of smoke sensors shall be distinguished by its label and history log entry as being activated by a magnet.

10. Sounder Base: 520 Hz low frequency tone.

N. Heat Detector based on Simplex 4098-9733:

1. General requirements for heat detectors: Comply with UL 521.

2. 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.

3. Heat detectors and combination smoke/heat detectors shall be programmed to provide a non-latching supervisory trouble signal for low temperatures at 40 °F.
   a. The supervisory trouble signal shall be programmed to report the low temperature reading.
   b. The signal shall be programmed to clear when temperatures rise above the 40 °F threshold.

4. Mounting: Twist-lock base interchangeable with smoke –detector bases.

5. Integral addressable module: Arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.

O. Addressable Interface device: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired application with normally open contacts.

1. Integral Relay: Capable of switching 120 VAC power to operate shunt trip mechanism in circuit breaker or 24 VAC for operating fire/smoke damper.
   a. 24 VAC transient suppressed loads: 2A.
   b. 24 VAC inductive loads: 1A.
   c. 120 VAc transient suppressed loads: 0.5A

P. Smoke Detectors: Maintenance and testing service providing the following shall be included with the base bid:

1. Biannual sensitivity reading and logging for each smoke sensor.

2. Scheduled biannual threshold adjustments to maintain proper sensitivity for each smoke sensor.

3. Threshold adjustment to any smoke sensor that has alarmed the system without the presence of particles of combustion.

4. Scheduled biannual cleaning or replacement of each smoke detector or sensor within the system.

5. Semi-annual functional testing of each smoke detector or sensor using the manufacturers calibrated test tool.

6. Written documentation of all testing, cleaning, replacing, threshold adjustment, and sensitivity reading for each smoke detector or sensor device within the system.

7. The initial service included in the bid price shall provide the above listed procedures on the sixth and eleventh month for a period of one (1) year after owner acceptance of the system.

Q. Audible Alarm Notification: By voice evacuation and tone signals on loudspeakers in areas as indicated on drawings.

1. Automatic Voice Evacuation Sequence:
   a. The audio alarm signal shall consist of an alarm tone for two cycles of ANSI temporal pattern followed by an automatic digital voice message. At the end of the voice message, the alarm tone shall resume. This sequence shall sound continuously until the "Alarm Silence" switch is activated.
   b. All audio operations shall be activated by the system software so that any required future changes can be facilitated by authorized personnel without any component rewiring or hardware additions.

R. Speaker: Speaker notification appliances shall be listed to UL 1480. Based on Simplex model 4902-9721, 4906-9251, and 4906-9254.

1. The speaker shall operate on a standard 70.7VRMS NAC using twisted/shielded wire.

2. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet. Speaker shall be tapped at 2 Watts unless specified otherwise. Speaker wattage will be adjusted during the test for intelligibility.

3. The speaker shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12 kHz for General Signaling.

S. Visual Notifications Devices: Based on Simplex 4906-9201, 4906-9202, 4906-9203, and 4906-9204. Wall or ceiling mount.

1. Addressable type.

2. Multi-candela 15,30,75,and 110. In specific rooms, provide 177 candela as indicated on the drawings.

3. Color shall be white or red. Owner selected.

T. Manual Voice Paging

1. The system shall be configured to allow voice paging. Upon activation of any speaker manual control switch, the alarm tone shall be sounded over all speakers in that group.

2. The control panel operator shall be able to make announcements via the push-to-talk paging microphone over the pre-selected speakers.

3. Facility for total building paging shall be accomplished by the means of an "All Call" switch.

U. Circuit Capacities:

1. Max limitation on power supplies – The design load placed on the power supply shall not exceed (60) sixty percent of the power supply capacity.

2. Individual signal circuits shall not exceed sixty percent of the card capacity. For voice systems this assumes that all speakers are tapped at their maximum wattage, which is currently 2 watts.

V. Power Requirements

1. The control unit shall receive AC power via a dedicated, NEC 700, 20A branch circuit as indicated on the drawings.

2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.

3. All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control unit.

4. The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously at the user interface while incoming power is present.

5. The system batteries shall be supervised so that a low battery or a depleted battery condition, or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.

6. The system shall support NAC Lockout feature to prevent subsequent activation of Notification Appliance Circuits after a Depleted Battery condition occurs in order to make use of battery reserve for front panel annunciation and control.

7. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.

8. Loss of primary power shall sound a trouble signal at the FACU. FACU shall indicate when the system is operating on an alternate power supply.

2.4 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Fire alarm control units shall comply with UL 864, and listed and labeled by an NRTL
   a. Basis of design: Simplex 4100ES.

2. It shall have components for required functionality. All functions associated with annunciation, control and programming shall be included. Include a microphone for announcement and a phone for fire fighter’s use.

2.5 REMOTE ANNUNCIATOR

A. General Requirements: Annunciator function shall match those of fire alarm control unit for alarm, supervisory, and trouble functions. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

B. Mounting: Flush mount cabinet, NEMA 250, Type 1.

C. 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. All alarm, supervisory, and trouble messages shall be described with enough detail to notify emergency and facility personal of the exact item. This shall include but not limited to room numbers, names, floor, associated equipment name/location, etc.

D. Include remote command center features and components including a microphone for announcement and a phone for fire fighter’s use.

2.6 FIRE-ALARM TERMINAL CABINET

A. UL listed, surface-mounted steel enclosure with hinged door, key lock, 0.5” and 0.75” conduit knockouts, red finish, and white lettering “FIRE ALARM TERMINAL CABINET”. The cabinet shall contain an 18 point (minimum) high barrier terminal strip and labeling ID card.

2.7 DIGITAL AALRM COMMUNICATOR TRANSMITTER

A. Listed and labeled under UL 864 and NFPA 72.

B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP panel, and automatically sends a signal via fiber optic remote cable through campus system to a central station. If service is lost on the fiber cable, the local trouble signal is initiated.

C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.

D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.8 SURGE PROTECTION DEVICES

A. The system shall be equipped with following surge protective devices to prevent damage or nuisance alarms by nearby lighting strikes, stray current, or voltage transient. The devices are to be provided by Simplex:

1. On AC Input.

2. On DC Circuits Extending Outside Building.

2.9 FIRE ALARM JUNCTION BOXES AND OTHER ITEMS

A. The exterior of all junction boxes containing fire alarm shall be painted red; box interior shall not be painted. Box covers for junction boxes containing fire alarm conductors shall be painted red on both sides. All painting of junction boxes and junction box covers shall be accomplished prior to installation of the boxes to avoid possible problems with overspray.

B. Box covers shall be labeled to indicate the circuit(s) or function of the conductors contained therein. Labels shall be neatly applied black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.

C. Circuit breaker feeding fire alarm panel shall be provided with lockable handle and breaker shall be painted red.

2.10 WIRE

A. Non-power-limited circuits: Solid copper conductors with 600V rated, 75 deg C, color coded insulation.

1. Low voltage circuits: No. 16 AWG minimum.

2. Line-voltage circuits: No. 12 AWG minimum.

B. Power limited circuits: NFPA 70, Types FPL, FPLR, or FPLP as recommended by fire alarm manufacturer meeting their performance criteria.

PART 1 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Equipment Mounting: Install fire-alarm control unit on wall with tops of cabinets not more than 75 inches above the finished floor.

C. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.

2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.

3. Smooth ceiling spacing shall not exceed 30 feet.

4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.

5. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

D. Audible Alarm-Indicating Devices: Install not less than 90 inches above finish floor.

E. Visible Alarm-Indicating Devices: Install so that bottom of device is a minimum of 80 inches and maximum of 96 inches above finish floor.

F. Device Location-Indicating Lights: Locate in public space near the device they monitor.

G. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 75 inches above the finished floor.

H. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.2 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 Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated air-conditioning duct systems.

2. Alarm-initiating connection to elevator recall system and components.

3. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.

4. Supervisory connections at valve supervisory switches.

5. Supervisory connections at elevator shunt trip breaker.

6. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.

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. Install framed instructions in a location visible from fire-alarm control unit.

C. Color of devices: Panels – beige; Pull stations – red; A/V devices – color at the University's discretion. All ceiling mounted devices shall be white. Color for ceiling mounted devices shall also be at the University's discretion.

3.4 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.

3.5 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 inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.
   a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
   b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

3. 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. All intervening room doors shall be shut during the test.

5. Test visible appliances for the public operating mode according to manufacturer's written instructions and ensure installation per contract documents, and per code.

6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

7. Test and inspections shall be done at the end of Phase 1 and again at the end of Phase 2 construction with the entire building.

D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports. A copy must also be provided to the State Fire Marshal’s Office.

G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 WIRING INSTALLATION

A. Addressable loop (signaling line) circuits shall be wired type FPL/FPLR/FPLP fire alarm cable, AWG 18 minimum, low capacitance, twisted shielded copper pair. Cable shield drain wires are to be connected at each device on the loop to maintain continuity, taped to insulate from ground, and terminated at the FACP. Acceptable cables include Atlas 228-18-1-ISTP, BSCC S1802s19 (same as EEC 7806LC), West Penn D975, D991 (AWG 16), D995 (AWG 14), or equal wire having capacitance of 30 pf/ft. maximum between conductors, Belden 5320FJ acceptable if only FPL rating needed. The cable jacket color shall be red, with red (+) and black (-) conductor insulation.

1. Unshielded cable, otherwise equal to the above, is permitted to be used if the manufacturer’s installation manual requires, or states preference for, unshielded cable.

B. All wiring shall be color coded Ail the circuits in the system shall be wired with AWG 14, minimum, stranded copper, THHN/THWN conductor, installed in metallic

conduits. Color Coded wires shall be in accordance with the following scheme, which shall be maintained throughout the system, without color change in any wire run:

1. Red (+)/White (-)
2. -Violet (+)/Gray (-)
3. Red jacket with Red(+)/Black(-)
4. - Blue (+)/Black (-)
5. Yellow (+)/Brown (-)

C. Detection or alarm circuits must not be included in raceways containing AC power or AC control wiring. Within the FACP, any 120 VAC control wiring or other circuits with an externally supplied AC/DC voltage above the nominal 24 VDC system power must be properly separated from other circuits and the enclosure must have an appropriate warning label to alert service personnel to the potential hazard.

D. There shall be no splices in the system other than at device terminal blocks, or on terminal blocks in cabinets. "Wire nuts" and crimp splices will not be permitted. Permanent wire markers shall be used to identify all connections at the FACP and other control equipment, at power supplies, and in terminal cabinets All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.

E. All circuits leaving the riser on each floor shall feed through a labeled terminal block in a hinged enclosure accessible from the floor. If building layout requires the terminal cabinet to be above a drop ceiling, its location must be clearly and permanently identified with a placard readable from floor. Terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.

F. All wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any two conductors shall be ten (10) megohms, as verified with a megger. Provide advance notice to the Engineer of record of these tests.

G. The system shall be electrically supervised for open or (+/-) ground fault conditions in SLC, alarm circuits, and control circuits. Removal of any detection device, alarm appliance, plug-in relay, system module, or standby battery connection shall also result in a trouble signal. Fire alarm signal shall override trouble signals, but any pre-alarm trouble signal shall reappear when the panel is reset.

3.7 PATHWAYS

A. All fire alarm system wiring shall be in metal conduit or surface metal raceway.

1. If cable size and the requirement to maintain a Class "A" loop on all Signaling Line Circuits cause conduit fill to exceed specified maximums for the 1/2" size; therefore, 3/4" raceway should be used.

2. PVC conduit is permitted to be used underground, in concrete, and in locations approved by the AHJ.

B. All conduits that penetrate outside walls from air-conditioned space must have internal sealing (duct-seal), to prevent condensation from infiltrating humid air.

3.8 DEMONSTRATION AND TRAINING

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 3111

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the Contract Documents apply to the work of this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Protection of existing trees.
2. Clearing and grubbing.
3. Removal of trees and other vegetation.
4. Topsoil stripping.

1.3 DEFINITIONS

A. Remove: Remove and legally dispose of items indicated. Removal includes digging out and off-site disposing of stumps and roots.

B. Tree Protection Zone: The area surrounding individual trees or groups of trees to be protected during construction and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

C. Topsoil: Friable, clay loam surface soil, found in varying depths.

1.4 MATERIALS OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees, plantings and other improvements adjoining the construction that might be misconstrued as damage caused by the Work.

1.6 PROJECT CONDITIONS

A. Traffic: Conduct site clearing operations to ensure minimum interference with roads,

streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction.

B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.

1. Protect existing improvements on adjoining properties and on Owner's property.
2. Restore existing improvements damaged by clearing operations to their original condition.
3. Ensure a secure perimeter for the livestock fencing is provided at all times.

C. The conditions existing at the time of inspection for bidding purposes will be maintained by the Owner to the extent practical. However, minor variations may occur due to natural occurrences prior to the start of clearing work.

D. Do not commence site-clearing operations until erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 TREE PROTECTION FENCING

A. Refer to details on the plans.

PART 3 - EXECUTION

3.1 Protection of Existing Trees and Vegetation

A. Refer to Section 015639.

3.2 SITE CLEARING

A. General: Remove trees, shrubs, grass and other vegetation as required to permit installation of the Work. Cut minor roots and branches of trees indicated to remain in a clean and careful manner, where such roots and branches obstruct installation of the Work.

B. Clearing and Grubbing: Clear site of trees, shrubs and other vegetation within the clearing limits indicated.

1. Completely remove stumps, roots, and other debris.
2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated. Place fill material in horizontal layers not exceeding 6 inches loose depth, and thoroughly compact to

a density equal to adjacent original ground.

3.3 Topsoil Stripping

A. Remove heavy growths of grass from areas before stripping.

B. Strip topsoil to whatever depths are encountered, but to a minimum of at least 4 inches.

C. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other material.

1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

D. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.

E. Temporarily stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles, if required, to prevent wind erosion.

1. Do not stockpile topsoil within tree protection zones.
2. Stockpile surplus topsoil to allow for respreading deeper topsoil.

F. Dispose of unsuitable or excess topsoil in a legal manner off-site.

3.4 DISPOSAL OF WASTE MATERIALS

A. Burning on Owner's Property: Burning is not permitted.

B. Removal from Owner's Property: Remove waste materials generated by clearing operations from Owner's property and dispose of in a legal manner off-site.

1. Remove waste materials and debris from the site in a manner to prevent spillage. Pavements and the area adjacent to the site shall remain free from mud, dirt and debris at all times.
2. Clean up debris resulting from site clearing operations continuously with the progress of the work.

END OF SECTION 311000

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SECTION 312000 - EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the Contract Documents apply to the work of this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Excavation, filling, backfilling, and grading indicated and necessary for proper completion of the work.
2. Preparing of subgrade for building slabs, walks, and pavements.
3. Drainage/porous fill course for support of building slabs.
4. Excavating and backfilling of trenches.
5. Detectable Warning Tape, Tracer Wire, and Marker Balls.

1.3 SUBMITTALS

A. VDOT approved Job Mixes for stone.

B. Borrow Soil (if required): Submit location of borrow pit and a sample of the soil for approval to the Owner’s Geotechnical Engineer a minimum of fourteen (14) working days prior to use.

C. Geotextile Fabric.

D. Detectable Warning Tape, Tracer Wire, and Marker Balls.

1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer 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: Aggregate layer 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. All excavation on this project shall be unclassified.

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: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.5 ADDITIONAL WORK

A. The General Conditions refer to certain conditions that may require additional excavation work. This paragraph is further defined herein and, where there are conflicts, is superseded by this section.

B. The risks of concealed, unknown, or unanticipated subsurface conditions shall be included in the Contract Amount and shall not be considered as grounds for additional costs to the Contract.

C. During construction, if concealed, unknown, or unanticipated subsurface conditions are encountered which require that footings, foundations or other parts of the building be raised, lowered or revised to provide acceptable bearing for the building or if, outside the building limits, additional depth of utility trench excavation below the design subgrade or subsoil elevations is required, immediately notify the Architect/Engineer upon discovery of such condition prior to disturbing the material encountered.

D. Payment for additional Work

1. No payment will be provided for rock, additional, or unauthorized excavation.
2. Lowering of footings shall be paid for at a negotiated amount.

1.6 EARTHWORK BALANCE ADJUSTMENTS

A. Adjustments of grades may be allowed with prior written approval of the Engineer in

order to accommodate shortfall or surplus of material that may occur. Should adjustments be allowed, maintenance of designed drainage patterns and required adjustments to drainage structures shall be a Contract responsibility. No additional payment will be made for these adjustments.

B. Importation of any required material shall be a Contract responsibility. No additional payment will be made for the importation of this material.

C. Excavation and disposal of any required material off-site in a legal manner shall be a Contract responsibility. No additional payment will be made for the export and disposal of this material.

1.7 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

B. Environmental Compliance:

1. Comply with the requirements of the latest edition of the Virginia Stormwater Management Handbook Versions 1.1 during earthwork operations.
2. Comply with the requirements of the latest edition of Virginia Tech’s Annual Standards and Specifications for Erosion and Sediment Control for Stormwater Management.

C. Testing and Inspection Service: Owner will employ and pay for an independent Geotechnical testing and inspection laboratory to perform soil testing and inspection service during earthwork operations. Cooperate with Owner’s Geotechnical Engineer as required for testing and inspection of work. These services do not relieve the responsibility for compliance with Contract Document requirements.

1.8 PROJECT CONDITIONS

A. Site Information: Data concerning subsurface materials or conditions, which are based on test borings, have been obtained by the Owner for use in designing the project. This data is contained in a Geotechnical Report titled “Geotechnical Engineering Report – Improve Center Woods Complex Project” dated November 4, 2024 by Hurt and Proffitt. Bidders and interested parties (prior to receipt of bids) are encouraged to review these reports.

1. The accuracy or completeness of the data is not warranted or guaranteed by the Owner or the Architect/Engineer. The Owner and Architect/Engineer expressly disclaim any responsibility for the data as being representative of the conditions and materials that may be encountered.

B. Bidders and interested parties (prior to receipt of bids) are encouraged to conduct their own soil and subsurface investigations, examinations, tests, and exploratory borings to determine the nature of the soil conditions underlying the project site. Contact the Owner's office to make an appointment to enter the site for the purpose of conducting

your own investigation prior to bid.

C. Existing Utilities: Do not interrupt existing utilities serving occupied facilities except when permitted under the following conditions and then only after arranging to provide acceptable temporary utility services.

1. All planned excavations on University property require notification by the CM/GC to the CAM within two hours of contacting MISS UTILITY. The notification to the CAM notifies only the University of an excavation planned by the CM/GC and does not result in notification of MISS UTILITY.
2. University is a subscriber to the MISS UTILITY underground utility location and notification system. Any excavation of state roads requires notification and coordination with the Virginia Department of Transportation (VDOT). All planned excavations require notification of MISS UTILITY per state and federal regulations. It is the responsibility of the CM/GC to notify MISS UTILITY at 1-800-552-7001 of the planned excavation and at 1-800-552-3120 to obtain subsequent verification that utilities have been marked.
3. Excavation shall not proceed without the completion of the above requirements.

1.9 SAFETY

A. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

1. Operate warning lights as recommended by authorities having jurisdiction and governing regulations and standards.
2. 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. Work within the road right-of-way shall meet all requirements of the latest edition of the Virginia Department of Transportation Work Area Protection Manual.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Refer to definitions and classifications within the Geotechnical Report for suitable soil classifications for different applications, including structural fill and unsuitable materials.

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; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Apparent Opening Size: No. 60 sieve, maximum; ASTM D4751.
3. Permittivity: 0.2 per second, minimum; ASTM D4491.
4. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Apparent Opening Size: No. 60 sieve, maximum; ASTM D4751.
3. Permittivity: 0.02 per second, minimum; ASTM D4491.
4. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting, flowable concrete material produced from the following:

1. Portland Cement: ASTM C150, Type I.
2. Fly Ash: ASTM C618, Class C or F.
3. Normal-Weight Aggregate: ASTM C33, 3/4-inch nominal maximum aggregate size.

2.4 ACCESSORIES

A. Warning Tape: Warning tape shall be acid- and alkali-resistant, polyethylene film with metal backing manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; color coded according to American Public Works Association (APWA) color.

B. Tracer Wire: Tracer wire shall be a tin coated, cooper conductor with polyethylene insulation water blocking utility locating system. Core material shall be comprised of high-tenacity, woven polyester with water blocking yarns encapsulated in a 30-mil thick HDPE jacket providing corrosion resistance, flexibility, impact strength, and 1800 lbs. tensile strength. Tracer wire shall not conduct an electrical current when struck by lighting and shall be designed for direct bury and directional boring applications. All tracer wire systems shall be designed and installed to last the lifetime of the utility it accompanies. Tracer wire shall be color coded according to American Public Works Association (APWA) color.

1. Access Box: Traffic rated access box to be placed in vehicular travel ways. Access boxes shall have the utility identification on the lid with lids painted per APWA code.
2. Ground Rod: Drive-in magnesium-grounding rod with a 10-gauge copper clad wire connected to ground rod and locate clip with a watertight cap.
3. Connections, splices, and repairs: Shall be made with water blocking gel filled polycarbonate, 10-19 AWG connectors. When splices and lateral connections

are made, only gel filled connectors designed for wire with a woven polyester fiber core are to be used and installed per the manufacturer's instructions.

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. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Section 311000 "Site Clearing."

C. Protect and maintain erosion and sedimentation controls during earthwork operations.

3.2 DEWATERING

A. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.

1. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrade and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rainwater and water removed from excavations to collecting or runoff areas. Do not use utility trench excavations as temporary drainage ditches.

B. Should any springs or running water be encountered in the excavation, notify the Architect/Engineer and provide discharge by trenches (or other acceptable means) and drain to an appropriate point of disposal. Provide temporary drainage facilities to minimize the flow of rainwater onto adjacent property. Repair any damage to property or to subgrade as a result of construction and/or dewatering (or lack thereof) operations at no additional cost to the Contract. If permanent provision must be made for disposal of water other than as indicated, the Contract price shall be adjusted.

3.3 EXPLOSIVES

A. Blasting is not permitted.

3.4 EXCAVATION

A. Excavation consists of removal, placement and disposal of material encountered when establishing required subgrade or finish grade elevations.

1. Excavation includes removal and disposal of pavements and other obstructions visible on ground surface; underground structures, utilities and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.

B. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

a. 24 inches outside of concrete forms other than at footings.
b. 12 inches outside of concrete forms at footings.
c. 6 inches outside of min. required dimensions of concrete cast against grade.
d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
e. 6 inches beneath bottom of concrete slabs-on-grade.
f. 6 inches beneath pipe in trenches and 24 inches wider than pipe.

3.5 EXCAVATION FOR BUILDING PAD AND STRUCTURES

A. Conform to elevations and dimensions indicated within a tolerance of plus or minus 0.10 foot and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction and for review.

B. Excavations for footings and foundations: Do not disturb bottoms of excavation. Excavate by hand to elevations required just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.

1. Where rock is encountered, carry excavation to required elevations and backfill with crushed stone prior to installation of footing.

C. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Structures: Conform to elevations and dimensions indicated within a tolerance of plus or minus 0.10 foot plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction and for review. Do not disturb bottom of excavations intended for bearing surface.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Cut surface under pavements to comply with cross-sections, elevations and grades as indicated.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches of clearance on both sides of pipe or conduit.

B. Excavate trenches to depth indicated or required to establish indicated slope and invert elevations and allow for the appropriating bedding. Refer to plan details for additional information.

3.8 EXCAVATION STABILITY

A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction.

B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

3.9 SUBGRADE INSPECTION

A. Notify the Owner’s Geotechnical Engineer when mass, trench, and footing excavations have reached required subgrade. The Contractor is responsible for arranging inspections of conditions by the Owner’s Geotechnical Engineer. Alternative procedures for arranging this review may be implemented at the Owner’s written option.

B. If the Owner’s Geotechnical Engineer determines that the subgrade bearing conditions are unacceptable, the Owner will authorize additional excavation until suitable bearing conditions are encountered.

C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less

than 15 tons.

3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the Owner's Geotechnical Engineer, and replace with compacted backfill or fill as directed.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Owner's Geotechnical Engineer, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

A. Correct Unauthorized Excavation as follows:

1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to Architect/Engineer.
2. Elsewhere, backfill and compact unauthorized excavations as indicated for authorized excavations of same classification unless otherwise directed.

3.11 STORAGE OF EXCAVATED MATERIALS

A. Temporarily stockpile excavated materials acceptable for use as backfill and fill. Place, grade, and shape stockpiles for proper drainage. Cover to prevent windblown dust.

1. Stockpile excavated materials away from edge of excavations. Do not store within the drip line of trees to remain.

3.12 BACKFILL AND FILL

A. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Acceptance by local authority having jurisdiction of construction below finished grade, including perimeter insulation.
2. Review, approval, and recording of the locations of underground utilities.
3. Removal of concrete formwork.
4. Removal of shoring and bracing (including backfilling of voids with satisfactory materials).
5. Removal of trash and debris from excavation.
6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow or ice.

C. Ground Surface Preparation: Remove vegetation, debris, obstructions, and deleterious materials from ground surface prior to placement of fills.

D. Bench sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material. Plow, scarify, bench or break up sloped surfaces flatter than 1 vertical to 4 horizontal so fill material will bond with existing material.

E. Place soil material in layers to required subgrade elevations, for each area classification listed below, using materials indicated in the Geotechnical Report.

1. Under grassed areas, use satisfactory excavated or borrow material.
2. Under walks, curbs, and pavements, use satisfactory structural excavated or borrow material.
3. Under building slabs, use satisfactory structural excavated or borrow materials and drainage/porous fill material as indicated.

3.13 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. All material specifications and dimensions for bedding and backfill shall be in accordance with:

C. Water: Virginia Tech’s Design and Construction Standards Manual, latest edition

D. Sanitary sewer: Virginia Tech’s Design and Construction Standards Manual, latest edition

E. Storm sewer: Virginia Tech’s Design and Construction Standards Manual, latest edition, and VDOT specifications.

F. 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.

G. Place and compact initial backfill over the utility pipe or conduit.

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.

H. Place and compact final backfill over initial backfill to final subgrade elevation. The final backfill material shall generally be classified as suitable fill in grass areas and VDOT 21A stone in pavement areas.

I. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

J. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.

K. 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.

L. Install warning tape directly above utilities.

M. Do not backfill trenches until any required testing and inspections have been completed and the Owner's Geotechnical Engineer and Geospatial Engineering Services authorizes backfilling. Backfill carefully to avoid damage or displacement of pipe systems.

N. Under piping and conduit and equipment, use crushed stone where required over rock bearing surface and for correction of unauthorized excavation. Shape excavation bottom to fit bottom 90 degrees of cylinder.

O. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

3.14 WARNING TAPE AND TRACER WIRE

A. Warning Tape: Warning tape shall be installed for all underground utilities. Tape shall be located at half of the distance between the top of the utility line and the approved finished grade height.

B. Tracer Wire: Tracer wire shall be installed on all underground utilities and brought to the surface at terminations points in approved access boxes no more than 500' apart. Tracer wire shall be installed along the full length of the utility and placed directly on top of the utility. Tracer wire is not to be looped or coiled at any point along the utility.

1. Tracer wire and ground rods must be accessible and protected in an access box. Traffic rated access box to be placed in vehicular travel ways. Access boxes shall be installed a minimum of 500 ft apart and 12 inches horizontal distance from the appurtenance. Access boxes shall have the utility identification on the lid. Tracer wire should extend a minimum of 18 inches above the top of the access box. Access box lids shall be painted per APWA code.
2. Tracer wire is to be grounded at all termination points and access boxes. The ground wire should be accessible within 3" of the top of the lid in access boxes. The ground Rod Shall be placed 90 degrees opposite the tracer wire at all dead-end stubs.
3. All connections, splices, and repairs shall be made with water blocking gel filled polycarbonate, 10-19 AWG connectors. When splices and lateral connections are made, only gel filled connectors designed for wire with a woven polyester fiber core are to be used and installed per the manufacturer's instructions.

3.15 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 3 percentage points 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 3 percentage points and is too wet to compact to specified dry unit weight.

B. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations. Maintain the moisture content of the structural fill materials to within 3 percentage points of the optimum moisture content until permanently covered.

C. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to required density.

1. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.
2. Work wet materials as directed by the Owner's Geotechnical Engineer. Base bids on working material daily for a maximum of five days of acceptable weather.
3. No additional payment will be made for these operations.

3.16 COMPACTION OF SOIL BACKFILL AND FILLS

A. Place backfill and fill 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. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

C. Control soil and fill compaction, providing minimum percentage of density indicated for each area classification indicated below. Correct improperly compacted areas or lifts as directed by the Owner's Geotechnical Engineer if soil density tests indicate inadequate compaction.

D. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density at a moisture content within 3 percentage points of optimum in accordance with ASTM D698:

1. Under structures, building pad and pavements, compact each layer of backfill or fill material at 95 percent maximum density.
2. Under grass or unpaved areas, compact each layer of backfill or fill material at 90 percent maximum density.

E. Seal all fill areas at the end of each working day, utilizing a smooth drum roller.

3.17 GRADING

A. General: Rough grading of areas within the Project, including cut and fill sections and adjacent transition areas, shall be reasonably smooth, compacted and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from either blade-grader or motor patrol except as otherwise indicated. The finished subgrade surface from the grassed areas generally shall be not more than 0.2 feet above or below the final grade or approved cross section, with due allowance for topsoil.

B. The tolerance for areas within 10 feet of building perimeter, walks and all areas to be paved shall not exceed 0.10 feet above or below the established subgrade. Finish all ditches, swales and gutters to drain readily. Unless otherwise indicated, evenly slope the subgrade to provide drainage away from building walls in all directions at a grade not less than ¼ inch per foot. Provide rounding at top and bottom of cut and fill slopes and at other breaks in grade.

C. Protection of Graded Areas: Protect newly graded areas and areas of cut, fill and design/subgrade elevations from the actions of the elements and from deterioration as a result of construction operations and weather conditions (frost, rains, snow, sleet, hail, etc.). Repair any settlement or washing that occurs prior to or after acceptance of the work. Fill to required subgrade levels any areas where settlement occurs. Protect trees to remain, and, at all areas of the Site where construction operations are in progress, provide protection for the safety of occupants of the existing facilities.

D. 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.

E. 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; but never outside ADA guidelines.
3. Pavements: Plus or minus 1/2 inch; but never outside ADA guidelines.

F. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 PAVEMENT SUBBASE COURSE:

A. General: Place subbase material, in layers of indicated thickness, over subgrade surface to support a pavement base course.

B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least at 12” width of shoulder simultaneously with compacting and rolling each layer of subbase course.

D. Placing: Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.

E. When a compacted subbase course is 6” thick or less, place material in a single layer. When more than 6” thick, place material in equal layers, except no single layer more than 6” or less than 3” in thickness when compacted.

F. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

G. On prepared subgrade, place subbase and base course under pavements and walks as follows:

1. Place base course material over subbase course under hot-mix asphalt pavement.
2. Shape subbase and base course to required crown elevations and cross-slope grades.
3. Place subbase and base course 6 inches or less in compacted thickness in a single layer.
4. 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.
5. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.19 BUILDING SLAB DRAINAGE COURSE

A. General: Place drainage/porous fill material, over subgrade surface to support concrete building slabs and sidewalks areas indicated.

B. Place drainage course on subgrades free of mud, frost, snow, or ice.

C. Placing: Place drainage/porous fill material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting material during placement operations.

D. When a compacted drainage course is indicated to be 6 inches thick or less, place material in a single layer. When indicated to be more than 6 inches thick, place material in equal layers, except no single layer more than 6 inches or less than 3 inches in thickness when compacted.

3.20 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction: Allow the Owner's Geotechnical Engineer to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.

1. If in the opinion of the Owner's Geotechnical Engineer, based on reports and inspection, subgrade or fills have been placed that are below required density, perform additional compaction and testing until required density is obtained.

B. The Owner will engage, and pay for, the services of a Geotechnical Engineer whose function shall be to afford complete engineering control by testing of the conditions of all footing subgrades, the placement of all structural fills under structures, building pad and pavement areas, and all compaction where required, and to observe the proof rolling of the building pad and pavement areas.

C. The Owner's Geotechnical Engineer will be present as deemed necessary during all phases of the Work requiring filling, compaction operations or testing. The Geotechnical Engineer will provide the Architect/Engineer with written certification that fill and compaction was completed with accepted materials in accordance with the Documents, and give a professional opinion regarding shrinkage or settlement of fill and safe load bearing capacity of fill.

D. Site Preparation and Proofrolling: The Owner's Geotechnical Engineer will determine if any additional excavation or in-place densification is necessary to prepare a subgrade for fill placement for slab or pavement support.

E. Fill Placement and Compaction: The Owner's Geotechnical Engineer will witness all fill operations and take sufficient in-place density tests to verify that the indicated degree of fill compaction is achieved. The Owner's Geotechnical Engineer will observe and approve borrow materials used and shall determine if their existing moisture contents are suitable/acceptable.

F. Footing Excavation Review: The Owner's Geotechnical Engineer will review the footing excavations for the building foundations. He will verify that the design bearing pressures are available and that no loose or soft areas exist beneath the bearing surfaces of the footing excavations.

G. The Owner's Geotechnical Engineer will submit copies each of his reports, recommendations and/or opinions to the Architect/Engineer and the Owner. Pertinent information will be provided to the Contractor as required.

3.21 EROSION CONTROL

A. Provide erosion control methods in accordance with requirements of the University's Annual Standards and Specifications for Erosion and Sediment Control and stormwater Management, DEQ's Virginia Stormwater Management Handbook, and as indicated in the Contract Documents.

3.22 PROTECTION

A. Repair and reestablish grades in settled, eroded, and rutted areas to indicated tolerances.

B. Reconditioning Compacted Areas: Where subsequent construction operations or adverse weather disturbs completed compacted areas, scarify surface, reshape, and compact to required density prior to further construction.

C. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work and eliminate evidence of restoration to greatest extent possible.

D. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

3.23 DISPOSAL OF WASTE MATERIALS

A. Removal from Owner's Property: Remove excess and/or waste materials, including trash and debris, and dispose of it off Owner's property in a legal manner.

B. Dispose of excess material and materials not acceptable for use as backfill or fill legally offsite.

C. Do not remove topsoil from site until it has been demonstrated to the Owner’s satisfaction that it is excess.

END OF SECTION 312000

SECTION 312500 - EROSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The provisions of the Contract Documents apply to the work of this Section.

B. DEQ's Virginia Stormwater Management (SWM) Handbook, latest edition.

C. Virginia Tech Annual Standards and Specifications for Erosion and Sediment Control and Stormwater Management, latest edition.

D. EPA's NPDES 2022 Construction General Permit (CGP)

1.2 SUMMARY

A. This Section includes the installation, maintenance and removal of erosion control measures required for prevention of sediment leaving the project site.

B. This Section also includes the requirement to file the Virginia Stormwater Management Program (VSMP) General Permit Registration Statement for Storm Water Discharges from Construction Activities with the State Department of Environmental Quality (DEQ).

C. For LEED compliance, all erosion and sediment control measures and inspections shall comply with the EPA's 2022 CGP or DEQ' Stormwater Management Handbook, whichever is stricter.

1.3 EROSION AND SEDIMENT CONTROL PRE-CONSTRUCTION

A. Prior to commencement of work, obtain a copy of the approved Erosion and Sediment Control Plan from the University.

B. Schedule a pre-construction conference with the Virginia Tech (VT) Department of Environmental Resources (ER). Hold this meeting prior to the start of any construction activities.

1.4 VSMP REGISTRATION

A. The VSMP Construction General Permit (CGP) will be applied for by the Contractor. The Engineer will provide a Registration Statement template and the AS&S Entity Form for the Contractor to finalize and sign. Prior to the pre-construction meeting, the Contractor shall complete the paperwork and file with DEQ to obtain coverage. The Contractor will be responsible for CGP application and renewal fees.

B. During construction, the following requirements shall be met:

1. A copy of the Stormwater Pollution Prevention Plan (SWPPP) shall be kept at the job site at all times. A SWPPP following the VT AS&S has been prepared by the Engineer and will be provided to the Contractor prior to the pre-construction meeting.
2. The Contractor shall amend the SWPPP as necessary to account for significant changes in design, construction, or maintenance that would increase the pollution potential of the site. All changes shall be documented in the SWPPP and be available for review by VT ER and the Engineer.
3. The Responsible Land Disturber or other personnel designated by the Contractor shall perform inspections of the erosion and sediment control measures in accordance with the CGP. Inspection reports shall be filed as an appendix to the SWPPP.
4. The Contractor is responsible for posting, maintaining, and updating the SWPPP throughout construction.

C. Following final acceptance of the site by the Owner and sign off by the VT ER, work with VT and the Engineer to file a Notice of Termination with DEQ.

1.5 SUBMITTALS

A. Responsible Land Disturber registration information.

B. Copies of the SWPPP inspection reports. Inspection reports should be maintained in the onsite SWPPP binder for review at the monthly progress meetings.

C. All materials used to satisfy erosion control plans.

D. All documentation required for stormwater management certification.

1.6 PAYMENT PROCEDURES FOR EROSION CONTROL MEASURES

A. Establish a line item in the Schedule of Values for Erosion Control Maintenance. Erosion control maintenance will be paid on a monthly basis, following the satisfactory installation and maintenance of the erosion control measures.

PART 2 - PRODUCTS

2.1 EROSION CONTROL PRODUCTS:

A. Construction Entrance

1. Heavy-duty stone aggregate and filter fabric construction entrance, complying with the requirements of Standard and Specification C-SCM-03 of the DEQ SWM Handbook.
2. Reinforced concrete wash-rack, draining to a sediment trapping measure.

3. The water source for washing operations shall be the responsibility of the Contractor.

B. Silt Fence and Super Silt Fence

1. Synthetic filter fabric, complying with the requirements of Standard and Specification C-PCM-04 of the DEQ SWM Handbook.
2. For silt fence, wooden stakes shall be 2” oak, a minimum length of five feet.
3. For super silt fence, 2.5-in galvanized or aluminum poles shall be used and shall be set at a maximum of 10 feet apart. Poles shall be installed to a minimum depth of 24 inches. Reinforced chain link fence shall be galvanized no. 11.5 gage steel wire with 2.25 inch opening.

C. Temporary Diversion Dike

1. Diversions shall be installed prior to disturbance of up slope land. The diversion shall be adequately compacted and shall provide positive drainage to the erosion control measure to which it is directly runoff to.
2. Apply temporary or permanent seeding and mulch to the diversion immediately following installation.

D. Storm Drain Inlet Protection

1. Drop Inlet Sediment Filter, complying with the requirements of Standard and Specification C-SCM-04 of the DEQ SWM Handbook.

E. Culvert Inlet Protection

1. Culvert Inlet Protection, complying with the requirements of Standard and Specification C-SCM-05 of the DEQ SWM Handbook.

F. Temporary Seeding

1. Temporary vegetative cover for disturbed areas, complying with the requirements of Standard and Specification C-SSM-09 of the DEQ SWM Handbook.

G. Permanent Seeding

1. Refer to Section “Lawns and Grasses” for permanent seeding requirements.

H. Tree Protection Fencing

1. Refer to plans for fence types and materials.

PART 3 - EXECUTION

3.1 INSTALLATION OF EROSION CONTROL MEASURES

A. Install all erosion and sediment control measures per the requirements of DEQ’s SWM

Handbook.

B. Protect all points of construction ingress and egress to the site to prevent tracking of mud onto public streets. Provide temporary construction entrances at all points of access to the site.

C. Clear only those areas necessary for installation of the perimeter erosion control measures. The balance of the site shall not be cleared or otherwise disturbed until the perimeter erosion control measures are installed, functional and approved by VT's ER Inspector.

D. Follow the construction sequence and install erosion control measures as indicated on the Drawings and as directed by the VT's ER Inspector.

E. Install additional measures as necessary to prevent sediment from leaving the project site.

3.2 MAINTENANCE OF EROSION CONTROL MEASURES

A. Maintain all erosion and sediment control measures per the requirements of DEQ's SWM Handbook.

B. At a minimum, the following maintenance is required:

1. Construction Entrance

    a. Wash and rework stone and/or place additional stone as required to prevent tracking of mud onto the roadways.
    b. Clean out the sediment-trapping device for the washrack.
    c. Remove all materials spilled, dropped, washed or otherwise tracked onto roadways or into storm sewers immediately. Do not use water trucks to wash the roadways.

2. Silt Fence

    a. Inspect immediately following each rainfall and at least daily during prolonged rainfall.
    b. Make any required repairs immediately. Give special attention to damage resulting from end-runs and undercutting.
    c. Replace fabric that is decomposing or is otherwise ineffective.
    d. Clean out accumulated sediment following every storm event. Do not allow sediment to accumulate higher than one-half the height of the barrier.

3. Storm Drain Inlet Protection

    a. Inspect immediately following each rainfall and at least daily during prolonged rainfall.
    b. Remove and clean or replace stone filters that have been clogged with sediment. Make any required repairs immediately.
    c. Remove accumulated sediment as required. Do not allow sediment to

accumulate higher than one-half the height of the measure.

4. Temporary Seeding

a. Re-seed and mulch areas where cover is inadequate to protect against erosion until adequate cover is obtained.

C. Remove accumulated sediment as required and at appropriate intervals to maintain the effective function of all erosion control measures.

D. Inspect, repair, and remove accumulated sediment from erosion control measures following significant (greater than ½") rainfall events.

E. If erosion control measures become clogged, causing the impoundment of water, restore the measures immediately. Ponded water poses a potential drowning hazard and shall be relieved immediately by either pumping (through an approved dewatering structure) or by removal of the blockage.

3.3 REMOVAL OF EROSION CONTROL MEASURES

A. Remove all temporary erosion control measures following the stabilization of the site. Do not remove erosion control measures until authorized by VT's ER Inspector.

B. Topsoil, permanently seed, and stabilize areas occupied by erosion control measures.

END OF SECTION 312500

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SECTION 321313 - SITE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the Contract Documents apply to the work of this Section.

1.2 DESCRIPTION OF WORK:

A. Extent of Portland cement concrete paving is shown on drawings, including:

1. Walkways
2. ADA Parking Areas
3. Driveway apron

1.3 SUBMITTALS

A. Job-Mix Designs: VDOT Certification of approval of each job mix proposed for the Work.

B. Material Certification: Certification signed by Contractor certifying that each material complies with requirements.

1.4 JOB CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.

1. Use flexible spring steel forms or laminated boards to form radius bends as required.
2. Coat forms with a nonstaining form release agent that will not discolor or deface surface of concrete.

B. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A 185.

C. Reinforcing Steel: ASTM A 615, Grade 60, deformed

D. Concrete Materials: Comply with requirements of applicable Division 3 sections for concrete materials, admixtures, bonding materials, curing materials, and others as required.

E. Expansion Joint Materials: Comply with requirements of applicable Division 7 sections for preformed expansion joint fillers and sealers.

F. Antispalling Compound: Combination of boiled linseed oil and mineral spirits, complying with AASHTO M-233.

G. Liquid-Membrane Forming and Sealing Curing Compound: Comply with VDOT Road and Bridge Specifications.

2.2 CONCRETE MIX, DESIGN, AND TESTING

A. Comply with requirements of applicable Division 3 sections for concrete mix design, sampling and testing, and quality control or VDOT Road and Bridge Specifications whichever is more stringent.

B. Design mix to produce normal-weight concrete consisting of Portland cement, aggregate, water-reducing or high-range water-reducing admixture (superplasticizer), air-entraining admixture, and water to produce the following properties:

1. Comply with the requirements of VDOT Std. Class A3 Concrete, unless otherwise indicated.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

B. Proof-roll prepared subbase surface to check for unstable areas and need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving,

3.2 FORM CONSTRUCTION

A. Set forms to required grades and lines, braced and secured. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.

B. Check completed formwork for grade and alignment to following tolerances:

1. Top of forms not more than 1/8 inch in 10 feet.
2. Vertical face on longitudinal axis, not more than 1/4 inches in 10 feet.

C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.

3.3 REINFORCEMENT

A. Locate, place and support reinforcement as specified in Division 3 sections, unless otherwise indicated.

3.4 CONCRETE PLACEMENT

A. General: Comply with requirements of applicable Division 3 sections for mixing and placing concrete or VDOT Road and Bridge Specifications whichever is more stringent.

B. Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase if required 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.

C. Place concrete by methods that prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with 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 dislocation of reinforcing, dowels, and joint devices.

D. Deposit and spread concrete in a continuous operation between transverse joints as far as possible. If interrupted for more than 1/2 hour, place a construction joint.

E. Fabricated Bar Mats: Keep mats clean and free from excessive rust, and handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.

F. Place concrete in 2 operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.

G. Remove and replace portions of bottom layer of concrete that have been placed more than 15 minutes without being covered by top layer or use bonding agent if acceptable to Architect.

3.5 JOINTS

A. General: Construct expansion, weakened-plane (contraction), and construction joints true to line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated.

B. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints in sidewalk at a spacing to match the width of the sidewalk, or as detailed on the plans. Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness, as follows:

1. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.
2. Sawed Joints: Form weakened-plane joints with powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.

C. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for more than 1/2 hour, except where such placements terminate at expansion joints.

1. Construct joints as indicated using standard metal keyway-section forms.

D. Expansion Joints: Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks, and other fixed objects, unless otherwise indicated.

1. Locate expansion joints at 30 feet o.c. for each pavement lane unless otherwise indicated.

E. Extend joint fillers full width and depth of joint, not less than 1/2 inch or more than 1 inch below finished surface with joint sealer.

F. Provide joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.

G. Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

H. Fillers and Sealants: Comply with VDOT requirements.

3.6 CONCRETE FINISHING

A. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.

B. After floating, test surface for trueness with a 10-ft. straightedge. Distribute concrete as required to remove surface irregularities and refloat repaired areas to provide a continuous smooth finish.

C. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/2-inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface.

D. After completion of floating and when excess moisture or surface sheen has disappeared, complete troweling and finish surface as follows:

1. Broom finish by drawing a fine-hair broom across concrete surface perpendicular to line of traffic. Repeat operation if required to provide a fine line texture acceptable to Owner.

E. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Architect.

3.7 CURING

A. Protect and cure finished concrete paving in compliance with applicable requirements of Division 3 sections. Use membrane-forming curing and sealing compound or approved moist-curing methods.

3.8 REPAIRS AND PROTECTIONS

A. Repair or replace cracked, broken or defective concrete curbs, sidewalk, and pavements as directed by Engineer or Owner.

B. Drill test cores where directed by Engineer when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just before final inspection.

END OF SECTION 321313

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SECTION 321700 - PAVEMENT MARKINGS, SIGNS AND SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the Contract Documents apply to the work of this Section.

1.2 SUMMARY

A. This Section includes, but is not limited to, the following:

1. Establishing the location of pavement markings and applying pavement markings for parking space lines, fire lane and accessible spaces.
2. Installation of signs for traffic control and accessible spaces.

1.3 QUALITY ASSURANCE

A. All work and materials shall conform to the requirements of the latest edition of the Virginia Department of Transportation (VDOT) Road and Bridge Specifications and Road and Bridge Standards, Virginia Tech's Signage Standards, and the Virginia Tech Desing and Construction Standards Manual.

B. All materials for signs shall conform to the requirements of the latest edition of the Virginia Department of Transportation (VDOT) Road and Bridge Specifications and Road and Bridge Standards and to the requirements of the latest edition of the Manual of Uniform Traffic Control Devices for traffic signs.

C. Installer Qualifications: Engage an experienced installer, who has successfully completed striping and signage projects similar in size and complexity to this project. The installer's primary business (defined as a minimum of 60% of total billings) shall be striping and signage.

1.4 SUBMITTALS

A. Product Data and written confirmation that the following materials are included on VDOT's list of approved construction materials:

1. Pavement marking material
2. Signs
3. Posts

PART 2 - PRODUCTS

2.1 PAVEMENT MARKINGS

A. Markings shall be VDOT Type B, Class 1 thermoplastic pavement markings conforming to the requirements of Section 246 and 704 of the VDOT Road and Bridge Specifications.

2.2 SIGNS AND POSTS

A. Signs shall conform to the requirements of Section 701 of the VDOT Road and Bridge Specifications. Signs shall be fabricated with encapsulated lens sheeting.

B. Signposts shall be square tube sign post conforming to the requirements of STP-1 of the VDOT Road and Bridge Standards.

2.3 CONCRETE

A. Concrete shall be Class A3, General concrete, conforming to the requirements of Section 217 of the VDOT Road and Bridge Specifications, unless otherwise noted.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION FOR PAVEMENT MARKING

A. Prepare surfaces in accordance paint in accordance with the requirements of Section 704 of the VDOT Road and Bridge Specifications and the manufacturer’s recommendations.

B. Apply pavement markings only when the ambient temperatures is above 50°F and less than 95°F, unless otherwise approved.

C. Allow pavement to cure for a period recommended by the manufacturer before applying pavement marking.

D. Clean surfaces thoroughly before application of paint. Remove, dust, dirt and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods as required.

E. Remove existing pavement markings, residual curing compounds and other coating adhering to the pavement with scrapers, wire brushes, waterblasting, sandblasting or mechanical abrasion as required. Areas of existing pavement affected by oil or grease shall be scrubbed with an approved chemical and rinsed thoroughly. Seal oil-soaked areas with shellac or primer after cleaning.

F. Pavement surfaces shall be dry and clean prior to painting. Pavement markings shall

not be applied within 24 hours following rain or other inclement weather or when rain is imminent.

G. Apply seal coat across the existing pavement to provide a uniform surface appearance.

3.2 APPLICATION OF PAVEMENT MARKING

A. Apply paint in accordance with the requirements of Section 704 of the VDOT Road and Bridge Specifications and the manufacturer's recommendations.

B. Lay out lines and markings to the width and length as indicated. All parking space lines shall be 4 inches wide.

C. Apply markings with an approved applicator.

D. Apply markings at manufacturer recommended rates.

3.3 INSTALLATION OF SIGNS

A. Install signs on signposts in accordance with the requirements of Section 701 of the VDOT Road and Bridge Specifications and STP-1 of the VDOT Road and Bridge Standards.

END OF SECTION 321700

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SECTION 331000 - EXTERIOR WATER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the Contract Documents apply to the work of this Section.

B. The New River Valley (NRV) Regional Water Authority Standards and Specifications

C. Virginia Tech Design and Construction Standards Manual (DCSM)

1.2 SUMMARY

A. This section includes water service piping, fire protection service mains, and appurtenances from the source of water to a point 5 feet outside the building.

1.3 SUBMITTALS

A. Product data for piping, valves, vaults, fire hydrants, and identification devices.

1.4 QUALITY ASSURANCE

A. Comply with local utility department and fire department standards pertaining to materials, meter boxes, hose threads and installation.

B. Comply with the requirements of the latest edition of the University’s DCSM

1.5 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, for shipping as follows:

1. Ensure valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends, flange faces, and weld ends.
3. Set valves in best position for handling. Set gate valves and fire hydrants closed to prevent rattling.

B. Storage: Use the following precautions for valves, including fire hydrants, during storage:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect valves from weather. Store valves indoors. Maintain valve temperature

higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.

C. Handling: Use a sling to handle valves, including fire hydrants, whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve 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.

1.6 PROJECT CONDITIONS

A. Site Information: Perform site surveys, research public utility records, and verify existing utility locations. Verify that exterior water system may be installed in compliance with the original design and referenced standards. Notify Engineer immediately of any discrepancies.

B. Coordinate connection to the existing water service with Virginia Tech Utilities and the NRV Regional Water Authority.

C. Existing Utilities: Locate and coordinate with VT in accordance with Section 312000.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate with interior water piping and interior fire protection piping.

B. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 GENERAL

A. All piping, valves, fittings, fire hydrants, meters, meter vaults, appurtenances and other products shall conform to the following requirements:

1. Public - The latest edition of the New River Valley Regional Water Authority
2. Private (VT) – VT DCSM.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation of the exterior water system shall comply with the requirements of the latest edition of the NRV Regional Water Authority construction standards and specifications (public) and VT DCSM (private).

3.2 PREPARATION OF BURIED PIPE FOUNDATION

A. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation throughout the length of the pipe.

B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with bedding material to indicated level.

C. Install pipe bedding as required by the NRV Regional Water Authority construction standards and specifications (public) and VT DCSM (private).

3.3 PIPE AND PIPE FITTINGS INSTALLATION

A. Depth of Cover: Provide minimum cover over piping of 42 inches below finished grade.

B. Water Service Termination: Terminate water service piping 5'-0" from building foundation in location and invert as indicated. Coordinate location with interior water piping and interior fire service piping. Provide temporary pipe plug for piping extension into building.

3.4 IDENTIFICATION INSTALLATION

A. Install underground warning tape and tracing wire for all piping as required. Refer to Section 312000 for additional information.

3.5 FIELD QUALITY CONTROL

A. Testing and Disinfection: Disinfect, flush, and test in accordance with the requirements of the latest edition of the NRV Regional Water Authority construction standards and specifications (public) and VT DCSM (private).

END OF SECTION 331000

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SECTION 333000 - SANITARY SEWERAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the Contract Documents apply to the work of this Section.

B. The Town of Blacksburg and the VPI Sanitation Authority

C. Virginia Tech Design and Construction Standards Manual (DCSM), Latest Edition

1.2 SUMMARY

A. This Section includes sanitary sewerage system piping and appurtenances from a point 5 feet outside the building to the point of disposal.

1.3 SUBMITTALS

A. Product data for sewer piping specialties.

B. Shop drawings for concrete sanitary manholes, including frames and covers.

C. Inspection and test reports, including video recordings.

1.4 QUALITY ASSURANCE

A. Environmental Compliance: Comply with applicable portions of the Virginia Department of Health pertaining to sanitary sewerage systems.

B. Utility Compliance: Comply with the requirements of the latest edition of the VT DCSM

1.5 DELIVERY, STORAGE, AND HANDLING

1. Do not store plastic structures in direct sunlight.
2. Do not store plastic pipe or fittings in direct sunlight.
3. Protect pipe, pipe fittings, and seals from dirt and damage.
4. Handle precast concrete manholes and other structures according to manufacturer's rigging instructions.

1.6 PROJECT CONDITIONS

A. Site Information: Perform site surveys, research public utility records, and verify existing utility locations. Verify that sanitary sewerage system piping may be installed in

compliance with original design and referenced standards.

B. Locate existing structures and piping to be closed and abandoned.

C. Remove and/or abandon the existing septic system and drainfield in accordance with Virginia Department of Health requirements.

D. Existing Utilities: Locate and coordinate with VT in accordance with Section 312000.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate with interior building sanitary drainage piping.

B. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. General: Provide pipe and pipe fitting materials compatible with each other. All materials shall comply with the requirements of the latest edition of the VT DCSM

2.2 MANHOLES

A. Precast Concrete Manholes, Steps, and Frames and Covers: Shall comply with the latest edition of the VT DCSM

2.3 CLEANOUTS

A. General: Provide cleanout plug with round cast-iron access frame and heavy-duty, secured, scoriated cast-iron cover in accordance with the requirements of the latest edition of the VT DCSM.

B. Sewer pipe fitting and riser to cleanout: 4” or 6" dia. PVC.

PART 3 - EXECUTION

3.1 PREPARATION OF FOUNDATION FOR BURIED SANITARY SEWERAGE SYSTEMS

A. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation, throughout the length of the pipe.

B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated level.

C. Install pipe bedding as required by the latest edition of the VT DCSM

3.2 PIPE INSTALLATION

A. Install the sanitary sewerage system in accordance with the latest edition of the VT DCSM

B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

C. Use manholes for changes in direction, except where a fitting is indicated. Use fittings for branch connections, except where direct tap into existing sewer is indicated.

D. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.

E. Install piping pitched down in direction of flow, at minimum slope of 2 percent, except where indicated otherwise.

F. Extend sanitary sewerage system piping to connect to building sanitary drains, of sizes and in locations indicated.

3.3 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. Join and install PVC pipe as follows:

1. Joints in accordance with ASTM D2855.
2. Installation in accordance with ASTM D1668 and ASTM D2774.

B. Join different types of pipe with standard manufactured couplings and fittings intended for that purpose.

3.4 MANHOLES

A. Install concrete manholes in accordance with the latest edition of the VT DCSM

B. Provide rubber joint gasket complying with ASTM C 443 at joints of sections.

C. Apply bituminous mastic coating at joints of sections.

3.5 CLEANOUTS

A. Provide cleanouts as indicated on the plans, and as required by the latest edition of the VT DCSM.

3.6 IDENTIFICATION INSTALLATION

A. Install underground warning tape and tracing wire. Refer to Section 312000 for additional information.

3.7 FIELD QUALITY CONTROL

A. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.

1. In large, accessible piping, brushes and brooms may be used for cleaning.
2. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
3. Flush piping between manholes, if required by local authority, to remove collected debris.

B. Interior Inspection: Inspect piping with a crawler style camera, or approved equal, to provide sufficient video quality to determine whether line displacement or other damage has occurred. It is the contractor’s responsibility to coordinate, complete, and pay for the inspections.

1. Make inspections after pipe between manholes and manhole locations has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
2. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects correct such defects, and reinspect.
3. Provide video recordings to Owner/Engineer for review.

C. 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 all completed piping systems (public and private) according to the requirements of the Blacksburg-VPI Sanitation Authority Construction Specifications and the VT DCSM.
3. Schedule tests and inspections with Blacksburg-VPI Sanitation Authority (public) or Owner’s testing agency (private) with at least 24 hours' advance notice.
4. Submit separate reports for each test.

END OF SECTION 333000

SECTION 334100 - STORM DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The provisions of the Contract Documents apply to the work of this Section.

B. Virginia Tech Design and Construction Standards Manual (DCSM)

C. Virginia Tech (VT) Annual Standards and Specifications for Erosion and Sediment Control and Stormwater Management (AS&S).

1.2 SUMMARY:

A. This Section includes the roof drainage collection system, the storm sewerage system piping and appurtenances from a point 5 feet outside the building to the point of disposal.

1.3 SUBMITTALS

A. Product data for:

1. Pipe
2. Structures
3. Frames and covers
4. Grates
5. Underground Detention Structure

B. Certification, signed by material producer and contractor, that standard precast and cast in place concrete storm drainage manholes and Drop Inlets comply with VDOT standards and specifications.

C. VDOT approved job mix for bedding stone.

D. Shop drawings for:

1. Storm Structures.
2. All components of the Stormwater Management Facilities.

E. Video recordings of storm sewer inspections.

F. Record drawings of installed storm drainage system.

G. All documentation required to achieve stormwater management certification through VT at the end of the project.

1.4 QUALITY ASSURANCE

A. Environmental Compliance: Comply with applicable portions of VT guidelines and regulations.

B. All materials shall be new and free of defects (i.e. pipe shall not have chipped spigots or bells).

1.5 PROJECT CONDITIONS

A. Site Information: Perform site surveys, research public utility records, and verify existing utility locations. Verify that storm sewerage system piping may be installed in compliance with original design and referenced standards.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Locate and coordinate with VT in accordance with Section 312000.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate with interior building storm drainage piping.

B. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials used for construction of the storm sewerage system shall comply with the requirements of the latest edition of the Virginia Department of Transportation Road and Bridge Standards and Road and Bridge Specifications and the VT DCSM.

2.2 PIPE AND FITTINGS

A. Provide pipe and pipe fitting materials compatible with each other. Pipe materials are indicated on the drawings.

B. Corrugated, Double Wall High Density Polyethylene Pipe (HDPE): Shall conform to the requirements of ASTM F2648 and have a smooth interior with angular exterior corrugations. Joints shall be watertight meeting the requirements of ASTM D3212. Gaskets installed by the pipe manufacturer shall meet the requirements of ASTM F477.

2.3 MANHOLES

A. Precast Concrete Manholes: Comply with the requirements of the latest edition of the

Virginia Department of Transportation's Road and Bridge Standards, and Road and Bridge Specifications.

B. Manhole Steps, Safety Slabs, and Inlet Shaping: Comply with the requirements of the latest edition of the Virginia Department of Transportation's Road and Bridge Standards, and Road and Bridge Specifications.

C. Manhole Frames and Covers: Comply with the requirements of the latest edition of the Virginia Department of Transportation's Road and Bridge Standards, and Road and Bridge Specifications.

2.4 DROP INLETS

A. Precast Concrete Drop Inlets: Comply with the requirements of the latest edition of the Virginia Department of Transportation's Road and Bridge Standards, and Road and Bridge Specifications.

B. Drop Inlet Steps, Safety Slabs and Inlet Shaping: Comply with the requirements of the latest edition of the Virginia Department of Transportation's Road and Bridge Standards, and Road and Bridge Specifications.

C. Drop Inlet Frames and Grates: Comply with the requirements of the latest edition of the Virginia Department of Transportation's Road and Bridge Standards, and Road and Bridge Specifications.

D. Yard Drain Basins: Comply with specifications on the plans.

2.5 CONCRETE AND REINFORCEMENT

A. Concrete: Conform to the requirements of VDOT Standard Class A3 concrete.

B. Reinforcement: Steel conforming to the following:

1. Fabric: ASTM A 185 welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615, Grade 60, deformed.

2.6 END SECTIONS

A. End sections: All end sections shall be reinforced concrete. Conform to the requirements of the latest edition of the VDOT Road and Bridge Specifications and the VDOT Road and Bridge Standards for the size of pipe indicated.

2.7 UNDERGROUND DETENTION

A. The underground detention shall follow product specifications and shall follow the size requirements as noted on the plans. The system used shall have a filtering system that is approved for 40% phosphorous removal per Virginia DEQ.

PART 3 - EXECUTION

3.1 GENERAL

A. Install the storm sewerage system in accordance with the latest edition of the Virginia Department of Transportation’s Road and Bridge Standards and Road and Bridge Specifications.

3.2 PREPARATION OF FOUNDATION FOR BURIED STORM SEWERAGE SYSTEMS

A. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation, throughout the length of the pipe.

B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated level.

C. Install pipe bedding conforming to the requirements of the latest edition of the Virginia Department of Transportation’s Road and Bridge Standards and Road and Bridge Specifications.

3.3 PIPE INSTALLATION

A. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

B. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.

C. Extend storm sewerage system piping to connect to building storm drains, of sizes and in locations indicated.

D. Join and install pipe and fittings per manufacturer’s recommendations.

E. Join different types of pipes with standard manufactured couplings and fittings intended for that purpose.

3.4 MANHOLES

A. General: Install manholes complete with accessories as indicated. Form continuous concrete or split pipe section channel and benches between inlets and outlet. Set tops of frames and covers flush with finish grade, unless otherwise indicated.

B. Place precast concrete manhole sections as indicated and install in accordance with

ASTM C 891.

C. Construct cast-in-place manholes as indicated.

D. Apply bituminous mastic coating at joints of sections.

3.5 DROP INLETS

A. Construct drop inlets to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.6 INLET SHAPING

A. Construct inlet shaping conforming to VDOT Standard IS-1 at all concrete drop inlets and manholes.

3.7 IDENTIFICATION INSTALLATION

A. Install underground warning tape and tracing wire. Refer to Section 312000 for additional information.

3.8 UNDERGROUND DETENTION

A. Schedule a pre-construction meeting with VT, the product manufacturer, and the Engineer prior to beginning construction.

B. The underground detention shall be kept off line for as long as possible or until all upstream areas have been stabilized.

C. Utilize the details on the plans for all dimensions.

D. The contractor shall document the installation at each step of the project with as-built elevations, photographs, and other information as needed to certify the facility.

3.9 FIELD QUALITY CONTROL

A. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.

1. In large, accessible piping, brushes and brooms may be used for cleaning.
2. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
3. Flush piping between manholes and drop inlets to remove collected debris. Flush pipes through an approved erosion and sediment control measure.

B. Interior Inspection: Inspect piping with a crawler style camera, or approved equal designed for large diameter pipes, to provide sufficient video quality to determine whether line displacement or other damage has occurred. It is the contractor's responsibility to coordinate, complete, and pay for the inspections.

1. Make inspections after pipe between manholes and manhole locations has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
2. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects correct such defects, and reinspect.
3. Provide video recordings to Owner/Engineer for review.

END OF SECTION 334100