

specifications

June, 2024

UTAH STATE UNIVERSITY

TAGGART STUDENT CENTER SKYROOM
REMODEL

650 N 800 E, Logan, UT 84322

project manual

prepared by;

ajc architects

703 east 1700 south, salt lake city, utah 84105

project no. 2022-19



PROJECT MANUAL
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UTAH STATE UNIVERSITY
TAGGART STUDENT CENTER SKYROOM REMODEL
650 N 800 E, Logan, UT 84322

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UTAH STATE UNIVERSITY
TAGGART STUDENT CENTER – THE SKYROOM REMODEL
LOGAN, UTAH 84321

SECTION 007213 –GENERAL CONDITIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. DFCM Form 08032020 "General Conditions" follow this cover page.

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Division of Facilities Construction and Management

GENERAL CONDITIONS

August 31, 2020

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GENERAL CONDITIONS

August 31, 2020

THESE GENERAL CONDITIONS (“General Conditions”) are part of and subject to the Contractor’s Agreement (defined below) between DFCM (defined below) and Contractor (defined below).

ARTICLE 1. GENERAL PROVISIONS.

1.1 DEFINITIONS.

ARCHITECT/ENGINEER OR A/E. “Architect / Engineer” or “A/E” means the person or entity practicing as a design professional, including architect, engineer, interior designer, and/or landscape architect, retained under separate agreement with DFCM to act on behalf of DFCM according to the Contract Documents (defined below) and the A/E’s employees, representatives and consultants. For Work (defined below) where there is no A/E hired by DFCM, references in these General Conditions to A/E shall be deemed to refer to DFCM’s Representative.

ADDENDA. “Addenda” means the written or graphic instruments issued prior to the execution of the Contractor’s Agreement (defined below) that clarify, correct, or change the bidding documents or the Contract Documents.

A/E’s SUPPLEMENTAL INSTRUCTION OR ASI. “A/E’s Supplemental Instruction” or “ASI” means a supplemental instruction issued by the A/E to Contractor that results in a clarification, correction, or minor change in the Work and does not affect the Contract Time (defined below) or the Contract Price (defined below).

AMENDMENT. “Amendment” means any document or communication that changes (or purports to change) the terms of Contractor’s Agreement and/or the General Conditions, except as to: (1) scope of the Work; (2) Contract Price; and/or (3) Contract Time. With the exception of Supplemental General Conditions (defined below), no Amendment shall be valid and/or binding on DFCM unless: (1) the Amendment is set forth in a separate document, clearly titled “Amendment”; and (2) the Amendment is specifically and expressly accepted in writing by the Director (defined below).

BID. “Bid” means the offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

BONDS. “Bonds” means collectively the bid bond, performance bond, payment bond, and any other instruments of security.

CHANGE ORDER. “Change Order” means a written instrument signed by both DFCM and Contractor, issued after the execution of the Contractor’s Agreement on DFCM’s form, authorizing: (1) a change in the Work; (2) an adjustment of the Contract Price; and/or (3) an adjustment of the Contract Time.

CLAIM. “Claim” means a dispute, demand, assertion or other matter submitted by Contractor, including a subcontractor at any tier, subject to the provisions of these General Conditions. The claimant may seek, as a matter of right, modification, adjustment or interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. A request for Preliminary Resolution Effort (“PRE”) (defined below) shall not be considered a “Claim”. A request for an amendment of the Contract Documents, requested Change Order or a Construction Change Directive (“CCD”) (defined below) is not a PRE or Claim unless agreement cannot be reached, and the procedures of these General Conditions are followed.

CONSTRUCTION CHANGE DIRECTIVE. “Construction Change Directive” means a written order signed by DFCM, issued after execution of the Contractor’s Agreement, directing Contractor to perform a change in the Work and stating a proposed basis for adjustment, if any, in the Contract Price and/or Contract Time.

CONTRACT DOCUMENTS. “Contract Documents” means collectively Contractor’s Agreement, these General Conditions of Contractor’s Agreement, applicable Supplemental General Conditions, Drawings (defined below), Specifications (defined below), Addenda, other documents listed in the Contractor’s Agreement, authorized Amendments and Supplementary Conditions and Modifications (defined below) issued after execution of the Contractor’s Agreement. The Contract Documents shall also include the bidding/proposal documents, including the Instructions to Bidders/Proposers, Notice to Contractors and the Bid/Proposal Form, to the extent not in conflict with the other above-stated Contract Documents and other documents and oral representations which are memorialized in writing and documented as an attachment to the Contractor’s Agreement.

CONTRACT PRICE. “Contract Price” means the total amount payable by DFCM to Contractor for performance of the Work, including any authorized changes in the Work.

CONTRACT TIME. “Contract Time” means the time within which Contractor shall complete the Work, including any authorized changes in the Work

CONTRACTOR. “Contractor” means the person or entity identified as such in the Contractor’s Agreement. As used in the Contract Documents, “Contractor” includes Contractor’s employees, agents, representatives, subcontractors at any tier, and any other third party hired by Contractor to perform a portion of the Work and is referred to throughout the Contract Documents as if singular in number.

CONTRACTOR’S AGREEMENT. “Contractor’s Agreement” means, unless the context requires otherwise, the agreement executed by the Contractor and DFCM for the Work.

DAY. “Day” or “days” means calendar day unless otherwise specifically defined.

DEFECTIVE. “Defective” is an adjective which when modifying the word “Work” refers to Work that does not conform to the Contract Documents, or does not meet the requirements of any inspection, referenced standard, code, test or approval referred to in the Contract Documents, or which fails to meet generally accepted craft standards, or which has been damaged.

DIRECTOR. “Director” means the Director of the Division of Facilities Construction and Management, unless the context requires otherwise. Director may include a designee selected by the Director for a particular function described in the Contract Documents.

DFCM. “DFCM” means the State of Utah, Division of Facilities Construction and Management. Unless the context requires otherwise, DFCM is the “Owner” as that term is commonly understood in the construction industry.

DRAWINGS. “Drawings” means the graphic and pictorial portions of the Contract Documents, wherever located and whenever issued, showing the design, location, and dimensions of the Work and generally includes drawings, elevations, sections, details, schedules, and diagrams, including electronic copies.

EXECUTIVE DIRECTOR. “Executive Director” means the Executive Director of the Utah Department of Administrative Services, including unless otherwise stated, the Executive Director’s duly authorized designee.

FINAL COMPLETION. “Final Completion” means the date when all Work to be performed by Contractor has been completed and accepted in writing by DFCM.

INSPECTION. “Inspection” or its derivatives means a review of the Work, including but not limited to a visual review of the Work completed to date to ascertain if the Work is in accordance with the Contract Documents, including all applicable building codes and construction standards.

MODIFICATION. “Modification” means: (1) a Change Order; (2) a Construction Change Directive; or (3) an ASI. Contractor’s Agreement may be amended or modified only by: (1) an authorized Amendment; or (2) a Modification.

NOTICE TO PROCEED. “Notice to Proceed” means a document prepared by DFCM that authorizes Contractor to commence Work. It shall be deemed issued upon being sent by DFCM to Contractor’s address specified in Contractor’s Bid.

PRELIMINARY RESOLUTION EFFORT OR PRE. “Preliminary Resolution Effort” or “PRE” means the processing of a request for preliminary resolution or any similar notice about an issue that could potentially lead to a Claim and is prior to reaching the status of a Claim.

PRODUCT DATA. “Product Data” means illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by Contractor to illustrate materials or equipment for some portion of the Work.

PROPOSAL REQUEST OR PR. “Proposal Request” or “PR” means a request made by DFCM to Contractor requesting a proposal to resolve an issue as part of the Change Order process.

PROPOSED CHANGE ORDER OR PCO. “Proposed Change Order” or “PCO” means a request by Contractor submitted to the DFCM Representative to commence the Change Order process. It shall not be considered a “PRE” or a “Claim”. The PCO may be related to any potential or actual delay, disruption, unforeseen condition or any other matter for which Contractor intends to seek an increase in the Contract Price and/or extension of the Contract Time.

REQUEST FOR INFORMATION OR RFI. “Request for Information” or “RFI” means a written request from Contractor to the A/E seeking information, direction, or clarification related to the Contract Documents, including Drawings and/or Specifications.

RULE. “Rule”, unless the context requires otherwise, means a rule of the Utah Administrative Code.

SALES TAX AND/OR USE TAX. “Sales Tax” and/or “Use Tax”, unless the context requires otherwise, means the sales tax and/or use tax collected or to be collected by the Utah State Tax Commission and shall

include any sales and/or use tax that the Utah State Tax Commission collects on behalf of any special district, local government, or political subdivision.

SAMPLES. “Samples” mean physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work shall be judged.

SHOP DRAWINGS. “Shop Drawings” means drawings, diagrams, schedules and other data specially prepared for the Work by Contractor, or a subcontractor at any tier, manufacturer, supplier or distributor to illustrate some portion of the Work.

SPECIFICATIONS. “Specifications” means that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction systems, standards, installation and workmanship for the Work and performance of related systems and services.

SUBCONTRACTOR. “Subcontractor” means any person or entity under contract with Contractor to provide services or labor for the Work. “Subcontractor” includes a trade contractor or specialty contractor. “Subcontractor” does not include suppliers who provide only materials, equipment or supplies to Contractor or a Subcontractor. The term “Subcontractor” is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or authorized representative of the Subcontractor. The term “Sub-subcontractor” means a person or entity that has a contract with a Subcontractor to provide services or labor for the Work and also includes all lower tier sub-subcontractors. The terms “Subcontractor” and “Sub-subcontractor” do not include a separate contractor retained by DFCM or subcontractors or sub-subcontractors of a separate contractor retained by DFCM.

SUBSTANTIAL COMPLETION. “Substantial Completion” and its derivatives means the date certified in accordance with *Section 9.3** when the Work, or a designated portion thereof, is sufficiently complete, and any lack of completion or performance does not materially interfere with DFCM’s intended use of the Work, in accordance with the Contract Documents, so that DFCM can occupy and use the Work for its intended use. DFCM’s “intended use” or “occupy” as used in this definition, shall include any intended use or occupation by any agency or entity that DFCM intends to use or occupy the Work.

**Revised numbering from ‘Section 9.2’ to ‘Section 9.3’ as of 07122023.*

SUPPLEMENTAL GENERAL CONDITIONS. “Supplemental General Conditions” means the Supplemental General Conditions identified on DFCM’s website, dfcm.utah.gov, applicable to the Work, if any, that supplements these General Conditions. Supplemental General Conditions are authorized Amendments.

SUPPLEMENTARY CONDITIONS. “Supplementary Conditions” means the part of the Contract Documents, if any, that amends or supplements these General Conditions and/or applicable Supplemental General Conditions. Supplementary Conditions, if authorized, are an Amendment.

WORK. “Work” means the construction, services, supervision, labor, tools, equipment, materials, products and transportation, to be furnished by Contractor, so as to fulfill the Contractor’s obligations as required by the Contract Documents.

ARTICLE 2. DFCM.

2.1 INFORMATION AND SERVICES REQUIRED OF DFCM.

2.1.1 DFCM’S REPRESENTATIVE. DFCM shall designate a representative authorized to act on behalf of DFCM with respect to the Work (“DFCM’s Representative”). Unless the context requires otherwise, “DFCM’s Representative” is the “Owner’s representative” as that term is commonly understood in the construction industry. DFCM’s Representative shall have authority to review and approve the Work, including

the time schedule for completion, and the authority (but not a duty) to stop the Work for any reason, including, without limitation, unsafe conditions, or to direct Contractor to remedy, repair, or replace any Work, if necessary, to ensure its proper execution. DFCM and DFCM's Representative shall endeavor to render decisions pertaining to documents submitted by the A/E and/or Contractor to avoid a delay in the orderly and sequential progress of the Work. Contractor shall be responsible for time lost and the cost of correcting Work that in DFCM's judgment was executed improperly. DFCM shall be the final interpreter of the Contract Documents; the decision of DFCM in the absence of arbitrary or capricious conduct shall be conclusive. Notwithstanding anything to the contrary in the Contract Documents, DFCM's approval shall not relieve Contractor of Contractor's sole responsibility for the Work.

2.1.2 SPECIALISTS AND INSPECTORS. DFCM shall provide building inspection services in accordance with the applicable building codes, including routine and special inspections unless otherwise noted in the Contract Documents. DFCM may assign an inspector or specialist to note deviations from, or necessary adjustments to, the Contract Documents or to report deficiencies or defects in the Work. The inspector's or specialist's activities in no way relieve Contractor from the responsibilities set forth in the Contract Documents.

2.1.3 SURVEYS AND LEGAL DESCRIPTION. Except to the extent not applicable to the type of Work to be performed pursuant to Contractor's Agreement, DFCM shall furnish surveys describing physical characteristics, legal limitations and utility locations for the Work site, and a legal description of the Work site. The Contractor shall be entitled to rely on the accuracy of such survey information furnished by DFCM but shall exercise proper precautions relating to the safe performance of the Work. The Contractor recognizes that the exact location of underground or hidden utilities, plumbing and electrical runs may be somewhat different from the location indicated on such surveys furnished by DFCM or in the Contract Documents. The Contractor shall exercise reasonable skill and care to locate underground or hidden utilities, plumbing and electrical runs that are to remain to prevent damage thereto. The Contractor shall review the survey information provided by DFCM and shall promptly provide written notice to DFCM of any survey information that Contractor knows or discovers to be inaccurate.

2.1.4 PROMPT INFORMATION AND SERVICES. Upon receipt of a written request from Contractor, DFCM shall endeavor to furnish information or services under DFCM's control with reasonable promptness to avoid delay in the orderly progress of the Work.

2.1.5 COPIES OF CONTRACT DOCUMENTS. Unless otherwise provided in the Contract Documents, DFCM shall provide or make available to Contractor, free of charge, paper or electronic copies of Contract Documents, as determined by DFCM, as are reasonably necessary for execution of the Work. DFCM's website may also provide Contract Documents for the Work.

2.2 CONSTRUCTION BY DFCM OR BY SEPARATE CONTRACTORS.

2.2.1 DFCM'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS. DFCM reserves the right to enter into contracts with third parties in connection with the Work and to perform construction or other activities itself on or about the Work site.

2.2.2 COORDINATION OF WORK. Contractor shall afford DFCM and the separate contractors or subcontractors retained by DFCM adequate opportunity for the introduction and storage of their materials and equipment and the execution of their work. Contractor shall properly connect and coordinate the Work with the work of DFCM and separate contractors or subcontractors.

2.2.3 COORDINATION OF SCHEDULES. Contractor shall cooperate with DFCM and any separate contractors and subcontractors hired by DFCM in performing the Work so that all portions of the Work may be completed in the shortest possible time within normal working hours. Contractor shall furnish separate contractors and subcontractors full information regarding time schedules for Contractor's Work. Contractor

shall coordinate the Work with the workers who may be retained by DFCM, all separate contractors and subcontractors, and their activities in the vicinity of the Work site.

2.2.4 REPORTING PROBLEMS TO DFCM. If part of Contractor's Work depends on work by DFCM or a separate contractor, Contractor shall, prior to proceeding with that portion of the Work, promptly report in writing to DFCM any apparent defects in workmanship of the work of DFCM and/or such separate contractor that would render it unsuitable for proper execution of the Work. Failure of Contractor to report defects shall constitute an acknowledgment that DFCM's or the separate contractor's completed or partially completed work is fit and proper to receive Contractor's Work, except as to defects in workmanship not then reasonably discoverable.

2.2.5 CONTRACTOR REMEDIAL WORK. If Contractor causes damage to the work of DFCM or any separate contractors or subcontractors, Contractor shall promptly remedy such damage and shall use all reasonable efforts to promptly negotiate a settlement with DFCM and such separate contractors and subcontractors.

ARTICLE 3. A/E.

3.1 A/E'S ADMINISTRATION OF THE CONTRACT.

3.1.1 IN GENERAL. The A/E shall assist DFCM in administering the Contract in accordance with the Contract Documents. The A/E shall have authority to act on behalf of DFCM, but only to the extent provided in the Contract Documents and/or A/E's agreement with DFCM.

3.1.2 SITE VISITS.

3.1.2.1 Site visits or inspections by the A/E or DFCM shall in no way limit or affect Contractor's responsibility to comply with all the requirements and the overall design concept of the Contract Documents as well as all federal, state, and local laws, rules, regulations, ordinances and orders of public authorities applicable to the Work.

3.1.2.2 The A/E shall promptly submit to DFCM a written report subsequent to each site visit detailing the visit.

3.1.3 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION. Except as authorized by DFCM or as otherwise provided in the Contract Documents, including these General Conditions, the A/E and Contractor shall communicate through DFCM on issues regarding the timing of the Work, cost of the Work, and scope of the Work. Communications by and with the A/E's consultants shall be through the A/E. Communications by and with Subcontractors shall ordinarily be through Contractor. Communications by and with separate contractors shall be through DFCM.

3.1.4 A/E MAY REJECT WORK, ORDER INSPECTIONS, TESTS. The A/E shall have the authority to reject Work which, based upon the A/E's knowledge or what may be reasonably inferred from the A/E's site observations and review of data, does not conform to the Contract Documents. Whenever the A/E considers it necessary or advisable for implementation of the intent of the Contract Documents, the A/E shall have the authority to require additional inspections or testing of the Work in accordance with the provisions of the Contract Documents, whether or not such Work is fabricated, installed, or completed; however, the A/E must obtain DFCM's prior written approval of any such additional inspections or testing. Neither this authority of the A/E nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the A/E to Contractor, Subcontractors, their agents or employees or other persons performing portions of the Work, including separate contractors. If Contractor disputes the rejection of any

Work and the correction thereof shall involve additional cost or time, it shall be DFCM's option to accept such Work whether it shall be conforming or nonconforming.

3.1.5 A/E REVIEW OF CONTRACTOR'S SUBMITTALS.

3.1.5.1 Contractor shall submit Shop Drawings, Product Data, and Samples and other submittals required by the Contract Documents to the A/E as required by the approved submittal schedule.

3.1.5.2 The A/E shall review and take appropriate action upon Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the purpose of checking for conformance with the information and design concepts expressed in the Contract Documents. A/E action taken on a submittal shall not constitute a Modification.

3.1.5.3 The A/E's action shall be taken no later than fourteen (14) days following A/E's receipt of the submittal, unless agreed to otherwise by Contractor and DFCM, in order to avoid a delay in the Work of Contractor or of separate contractors while allowing sufficient time in the A/E's professional judgment to permit adequate review.

3.1.5.4 Review of such submittals shall not be conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of Contractor as required by the Contract Documents.

3.1.5.5 The A/E's review of Contractor's submittals shall not relieve Contractor of Contractor's obligations under the Contract Documents.

3.1.5.6 The A/E's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the A/E, of any construction means, methods, techniques, sequences, or procedures.

3.1.5.7 The A/E's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

3.1.5.8 When professional certification of performance characteristics of materials, systems, or equipment is the responsibility of the Contractor under the Contract Documents, the A/E shall be entitled to rely upon such certifications to establish that the materials, systems or equipment shall meet the performance criteria required by the Contract Documents.

3.2 OWNERSHIP AND USE OF A/E'S DRAWINGS, SPECIFICATIONS AND OTHER DOCUMENTS. All Drawings, Specifications, and other documents prepared by the A/E for the Work are and shall remain the property of DFCM, and DFCM shall retain all common law, statutory, and other reserved rights with respect thereto. Said documents are intended for use as an integrated set for the Work. Neither Contractor nor A/E shall modify or use Contract Documents on any other project without the prior written consent of DFCM. Any such non-permissive use or modification by Contractor, Contractor's Subcontractors at any tier, or anyone else for whose acts Contractor is liable, shall be at Contractor's sole risk. To the fullest extent permitted by law, Contractor shall release, indemnify, hold harmless, and defend DFCM, and require all Subcontractors to release, indemnify, hold harmless, and defend DFCM, from and against any and all liabilities, claims, demands, actions, damages, losses, and expenses, including but not limited to attorney fees and costs of litigation, arising out of such non-permissive use or modification by Contractor or its Subcontractors. Contractor, including its Subcontractors, are granted a limited license to use and reproduce applicable portions of the Drawings, Specifications, and other documents prepared by the A/E appropriate to and for use in the execution of the Work. Contractor shall preserve the copyright notice, if any, shown on the Drawings, Specifications and other documents prepared by the A/E for the Work, on all copies. Submittals or distributions

necessary to meet official regulatory requirements or for other purposes relating to the Work shall not be construed as a publication in derogation of DFCM's copyright or other reserved rights.

ARTICLE 4. CONTRACTOR.

4.1 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR.

4.1.1 REVIEW OF DOCUMENTS. Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by DFCM and shall at once report to DFCM and A/E all errors, omissions, inconsistencies and/or ambiguities discovered. Contractor shall not be liable to DFCM or A/E for damage resulting from errors, omissions, inconsistencies and/or ambiguities in the Contract Documents unless Contractor recognized such error, omission, inconsistency and/or ambiguity or a contractor of ordinary skill and expertise for the type of Work involved would have readily so recognized such error, omission, inconsistency and/or ambiguity, and Contractor failed to report such to DFCM and A/E. If Contractor performs any Work without such notice to DFCM and A/E and prior to resolution of the error, omission, inconsistency and/or ambiguity, Contractor shall be responsible for such performance and shall bear the costs for correction.

4.1.2 REVIEW OF FIELD CONDITIONS. Contractor shall take field measurements, verify field conditions and carefully compare such field measurements and conditions and other information known to Contractor, or information that a contractor of ordinary skill and expertise for the type of Work involved would have known, before commencing Work. Contractor shall immediately report to DFCM and A/E all errors, omissions, inconsistencies and/or ambiguities discovered. If Contractor performs any Work without such notice to DFCM and A/E and prior to resolution of the error, omission, inconsistency and/or ambiguity, Contractor shall be responsible for such performance and shall bear the costs for correction.

4.1.3 SUBSURFACE INVESTIGATIONS. If DFCM has provided the Contractor with reports of subsurface investigations and/or tests of soils at the Work site ("Geotechnical Report") as part of the Contract Documents, the Contractor may rely upon the accuracy of the technical data contained in such Geotechnical Report at the locations where the data was obtained and to the depth indicated. However, Contractor acknowledges that the conditions indicated in any Geotechnical Report of any subsurface investigations and/or tests of soils at the Work site may not be representative of conditions existing at locations and/or at depths other than where data was obtained or that conditions different than those indicated by such Geotechnical Report may exist at the Work site. Contractor shall not be entitled to any increase in the Contract Price and/or increase in the Contract Time based on any data, opinion and/or recommendation in any Geotechnical Report and/or any inaccuracy, incompleteness, mistake and/or error in any Geotechnical Report except to the extent that Contractor is entitled to an increase in the Contract Price and/or extension of the Contract Time for a concealed or unknown condition as provided in Section 7.1.5.

4.1.4 PERFORM IN ACCORDANCE WITH CONTRACT DOCUMENTS AND SUBMITTALS. Contractor shall perform the Work in accordance with the Contract Documents and submittals to which no exception has been taken in accordance with the Contract Documents.

4.1.5 PERFORMANCE TO PRODUCE THE COMPLETE SYSTEM AND INTENDED RESULTS. The Contract Documents shall be read as a whole and wherever possible, the provisions shall be construed in order that all provisions are operable. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by Contractor, whether or not specifically set forth in the Contract Documents, for the Contract Price and within the Contract Time. Performance by Contractor shall be required to the extent consistent with and reasonably inferable from the Contract Documents as being necessary to allow the Work to function for its intended use.

4.1.6 INTENT AND HIERARCHY. The Contract Documents are complimentary, and what is required by one Contract Document or provisions thereof, shall be as binding as if required by all the Contract

Documents or provisions thereof. In case of an irreconcilable conflict between provisions within a Contract Document or between Contract Documents, the following priorities shall govern as listed below:

4.1.6.1 A Modification or authorized Amendment (including authorized Supplementary Conditions) shall govern over all Contract Documents listed in Sections 4.1.6.2 – 4.1.6.6 or previous Modifications or authorized Amendments (including authorized Supplementary Conditions).

4.1.6.2 The Contractor’s Agreement shall govern over all Contract Documents listed in Sections 4.1.6.3 - 4.1.6.6.

4.1.6.3 Supplemental General Conditions shall govern over all Contract Documents listed in Sections 4.1.6.4 – 4.6.1.6.

4.1.6.4 These General Conditions shall govern over the Contract Documents listed in Sections 4.1.6.5 – 4.1.6.6.

4.1.6.5 The Drawings and Specifications shall govern over the Contract Documents listed in Section 4.1.6.6.

4.1.6.6 Attachments to the Contractor’s Agreement, Contractor’s management plan, bidding/proposal documents, including the Instructions to Bidders/Proposers, Notice to Contractors and the Bid/Proposal Form and/or documented interview information, if any, are Contract Documents, binding on Contractor, but are subordinate to the Contract Documents listed in Sections 4.1.6.1 – 4.1.6.5.

4.1.6.7 An Addendum shall govern over all other Contract Documents and any previously issued Addendum.

4.1.6.8 In case of a conflict or ambiguity within the same level of hierarchy of described documents, DFCM reserves the right to revise the documents to select the most stringent requirement unless the preponderance of the Contract Documents indicate a less stringent requirement.

4.1.7 DIVIDING WORK AND CONTRACTOR REPRESENTATION. Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings, shall not control Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Contractor shall ensure that the Subcontractors at any tier, manufacturers and suppliers engaged or to be engaged by Contractor, are and shall be familiar with the requirements for performance by them of their obligations.

4.1.8 PLANNING AND PRIORITY. Contractor shall plan and schedule the Work and shall maintain the schedule to Substantially Complete the Work within the Contract Time.

4.2 SUPERVISION AND REPRESENTATIVES.

4.2.1 SUPERVISION AND CONTROL. Contractor shall supervise and direct the Work using Contractor’s best skill and attention to complete the Work within the Contract Time. Contractor shall be solely responsible for and have control over the construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work, except to the extent that the Contract Documents specifically and expressly state otherwise.

4.2.2 PERSONS PERFORMING WORK. Contractor shall perform the Work using qualified employees, consultants, and Subcontractors selected and paid for by Contractor, adequately trained in the requirements of their particular jobs, and skilled in the Work assigned to them. Contractor shall use all

reasonable efforts to maintain a stable project team and minimize changes in key members of the team where loss of key members could have an adverse impact on the Contract Time. Any change in key personnel assigned to the Work must be approved by DFCM in writing.

4.2.3 DESIGNATED REPRESENTATIVES. Contractor shall employ a competent superintendent and necessary assistants, fluent in spoken and written English, who shall be at the Work site during performance of the Work. Contractor's superintendent shall maintain communication between DFCM, the A/E, and Contractor and be responsible for the management of Contractor's activities and deliverables described in the Contract Documents, as well as management of any third-party resources hired by Contractor to provide services or products under the Contract Documents. Contractor's superintendent shall represent Contractor, and communications given to the superintendent shall be as binding as if given to Contractor. Important communications shall be confirmed in writing. Other communications shall be similarly confirmed in writing on written request in each case.

4.2.4 DISCIPLINE AND COMPETENCE. Contractor shall enforce safety procedures, strict discipline, and good order among Contractor's employees, Contractor's Subcontractors, agents, representatives and other persons performing the Work under the Contract Documents. If DFCM reasonably determines that a particular person does not follow safety procedures, is unfit or unskilled for the assigned Work, disregards instructions, ignores the environmental restraints of the Work, or jeopardizes the goodwill between DFCM and the public, Contractor shall immediately replace the person upon receipt of DFCM's request to do so and shall not employ the person again on the Work.

4.2.5 RESPONSIBILITY. Contractor shall be responsible to the State of Utah and DFCM for the acts and omissions of Contractor's employees, Subcontractors and their agents and employees and other persons performing portions of the Work under a contract with Contractor or on behalf of Contractor.

4.2.6 NOT RELIEVED OF OBLIGATIONS. Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of DFCM or DFCM's agents in DFCM's administration of the Contractor's Agreement, or by tests, inspections, or approvals required or performed by persons other than Contractor or for those that Contractor is liable.

4.2.7 INSPECTIONS AND APPROVALS.

4.2.7.1 All Work performed by Contractor shall be subject to the inspection and approval of DFCM to determine whether the Work is in accordance with the Contract Documents. Contractor shall permit and facilitate inspection of the Work at all times by DFCM, DFCM's representatives and governmental authorities having jurisdiction.

4.2.7.2 Contractor shall be responsible for requesting inspections for various stages and portions of the Work required under the Contract Documents in a timely manner in accordance with the process and document requirements of the applicable inspection authority. In the event Work is not in a condition to be inspected at the time scheduled for the inspection of such Work for causes for which the Contractor is responsible, Contractor shall bear all associated costs and expenses without reimbursement by DFCM.

4.2.7.3 If any of the Work is required to be inspected or approved by the terms of the Contract Documents, Contractor shall timely request such inspection or approval to be performed in accordance with Article 9. Except as provided in Article 9, Work shall not proceed without any required inspection and the associated authorization to proceed. Contractor shall promptly notify DFCM if the inspector fails to appear at the site.

4.2.7.4 Contractor shall work with the inspector to maintain an Open Issues Log and Contractor shall proceed diligently to resolve all open issues.

4.3 PAYMENT BY CONTRACTOR. Except to the extent it is otherwise stated in the Contract Documents, Contractor shall provide and pay for all supervision, labor, tools, equipment, materials and transportation, including, without limitation: construction equipment and machinery; water; heat; utilities; and other facilities, supplies, consumables and services necessary for the proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

4.4 TAXES AND OTHER PAYMENTS TO GOVERNMENT. Contractor shall pay Sales Tax and/or Use Tax, consumer, employment-related and similar taxes related to the Work or portions thereof provided by Contractor which are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect. Contractor shall comply with the laws and regulations regarding the payment of Sales Tax and/or Use Tax and any exemptions. The procurement documents may have a provision regarding specific items which are exempt from State of Utah Sales Tax and/or Use Tax. Any such exemption shall be used only for the items and the project specified in the procurement documents. Any such exemption does not apply to taxes levied by the federal government or any taxing entity outside of the State of Utah. If Contractor properly relies upon a provision(s) of the bidding or proposal documents indicating exemption from State of Utah Sales Tax and/or Use Tax, and if State of Utah Sales Tax and/or Use Tax subsequently becomes due, then Contractor shall be paid such tax amount not included in the bid/proposal amount due to the reliance upon such provision.

4.5 PERMITS, FEES, NOTICES, LABOR AND MATERIALS.

4.5.1 PERMITS AND FEES. Unless otherwise required in the Contract Documents, it shall not be necessary for Contractor to obtain or pay for local building permits, plan check fees, electrical permits, plumbing permits, connection fees, or impact fees, nor shall it be necessary to pay fees for inspections pertaining thereto.

4.5.2 COMPLIANCE, NOTICES. Contractor shall comply with and give notices required by all federal, state, and local laws, rules, regulations, ordinances, and orders of public authorities applicable to the Work.

4.5.3 CORRELATION OF CONTRACT DOCUMENTS AND LAW. It is not Contractor's responsibility to ascertain that the Contract Documents are in accordance with applicable federal, state and/or local laws, rules, regulations, ordinances, and/or orders of public authorities having jurisdiction. However, if Contractor observes, or if such would be readily observable to a contractor of ordinary skill and expertise for the type of Work involved, that a portion of the Contract Documents is at variance therewith, Contractor shall promptly notify the A/E and DFCM in writing, and necessary changes shall be accomplished by appropriate Modification and/or Amendment.

4.5.4 FAILURE TO GIVE NOTICE. If Contractor, or any Subcontractor, performs Work without complying with the requirements of this Section 4.5, Contractor shall assume responsibility for such Work and shall bear the appropriate amount of the applicable costs of correction.

4.6 TIME AND CONTRACTOR'S CONSTRUCTION SCHEDULES.

4.6.1 PROGRESS AND COMPLETION.

4.6.1.1 Time is of the essence in this Contract. By executing the Contractor's Agreement, Contractor confirms that the Contract Time is adequate to perform the Work. The Contractor shall proceed expeditiously with adequate forces to achieve Substantial Completion within the Contract Time.

4.6.1.2 Contractor shall commence and complete the Work within the Contract Time and pursuant to the schedule, an initial version of which shall be prepared and provided by Contractor to DFCM and the A/E for approval, as it may be modified with DFCM's consent. Unless and except to the extent that preliminary Work at the Work site is authorized in writing by DFCM, Contractor shall not prematurely commence the Work at the Work site or elsewhere until DFCM issues a Notice to Proceed or prior to the effective date of insurance required by Article 10 to be furnished by Contractor, whichever is later. Contractor shall proceed expeditiously with adequate forces to achieve Substantial Completion within the Contract Time. All other Work shall be completed no later than the date established for Final Completion. Contractor shall notify DFCM when Contractor considers the entire Work to be completed. DFCM shall be entitled to a final inspection to determine whether the Work has been completed in accordance with the Contract Documents. The date of Substantial Completion shall be established by a certificate of Substantial Completion issued by the A/E or a written acknowledgement of Substantial Completion signed by DFCM.

4.6.1.3 INITIAL CONTRACT TIME. Unless otherwise specified in the bidding documents, the initial Contract Time shall be the time identified in the Contractor's Agreement.

4.6.2 SCHEDULE PREPARATION.

4.6.2.1 Promptly after being awarded the Work, Contractor shall prepare and submit for DFCM's and the A/E's approval, a planned progress schedule for the Work. Contractor shall plan and schedule the Work to facilitate the Work and shall maintain a schedule to place proper priority to sequence the Work to complete the Work within the Contract Time. Contractor shall commence and complete the Work by the dates set forth in the agreed upon schedule and Contractor's Agreement.

4.6.2.2 The schedule shall include a time-line for procurement, fabrication, construction, and testing activities, including interdependence of items necessary to complete the Work, duration of activities, interim completion dates, milestones, closeout and commissioning, submittals, and critical path.

4.6.2.3 Contractor shall advise and consult with DFCM during progress of the Work and keep DFCM fully informed as to the status of the Work at intervals as required by DFCM. Contractor shall provide DFCM with a daily listing of personnel and equipment used on the Work. If the Work is not on schedule, Contractor shall immediately advise DFCM in writing of Contractor's proposed action to bring it on schedule.

4.6.2.4 DFCM may take reasonable exception to activity duration, activity placement, construction logic, and time frame for any element of the Work to be scheduled and may recommend revisions.

4.6.3 SCHEDULE SUBMITTAL.

4.6.3. Contractor shall develop the CPM schedule using Primavera, MS Project or Phoenix unless otherwise authorized by DFCM. The critical path shall be identified, including the critical paths for interim completion dates and milestones.

4.6.3.2 Contractor shall update the schedule at least once a month and submit the updated schedule with each Application for Payment.

4.6.3.3 No progress payments shall be approved until Contractor has submitted a detailed CPM schedule covering the first ninety (90) days of the Work with a general CPM schedule for the entire Work. The detailed schedule for the entire Work shall be completed prior to the second Application for Payment, unless otherwise authorized in writing by DFCM.

4.6.4 SCHEDULE CONTENT REQUIREMENTS.

4.6.4.1 The schedule shall indicate the duration of activities and order, sequence and interdependence of all items known to be necessary to complete the Work, including construction, procurement, fabrication and delivery of materials and equipment, commissioning, submittals and approvals of submittals or other documents. Work items of DFCM, other contractors, utilities, and other third parties that may affect or be affected by Contractor shall be included.

4.6.4.2 If DFCM is required by the Contract Documents to furnish any materials, equipment, or other items to be incorporated into the Work by Contractor, Contractor shall submit, with the first schedule submittal, a letter clearly indicating the dates that such items are required at the Work site.

4.6.4.3 The schedule shall indicate an early Substantial Completion date for the Work that is no later than the Work's required Substantial Completion date.

4.6.4.4 The schedule, including duration of all activities, shall be given in calendar days and indicate all of the following:

4.6.4.4.1 Interfaces with the Work of outside contractors (e.g., utilities, power, and any separate contractors retained by DFCM);

4.6.4.4.2 Description of activity including activity number/numbers;

4.6.4.4.3 Estimated duration time for each activity and remaining duration;

4.6.4.4.4 Early start, late start, early finish, late finish date, and predecessor/successors including stop-start relationships with lead and lag time for each activity – all activities shall have a predecessor and a successor, except for the start milestone and finish milestone;

4.6.4.4.5 Total Float and Free Float available to each path of activities;

4.6.4.4.6 Actual start date for each activity begun;

4.6.4.4.7 Actual finish date for each activity completed;

4.6.4.4.8 The percentage complete of each activity in progress or completed;

4.6.4.4.9 Identification of all critical path activities;

4.6.4.4.10 The critical path for the Work, with the path of activities being clearly and easily recognizable on the time-scaled network diagram. The path(s) with the least amount of float must be identified. Except as may otherwise be explicitly and specifically provided in the Contract Documents, no more than forty-percent (40%) of all activities may be identified as critical path items. The relationship between non-critical activities and activities on the critical path shall be clearly shown on the network diagram. Near critical path activities shall also be identified;

4.6.4.4.11 Unless otherwise authorized by DFCM, all activities on the schedule representing construction on the site may not have a duration longer than fourteen (14) days. Construction items that require more than fourteen (14) days to complete must be broken into identifiable activities on the schedule with durations less than fourteen (14) days. The sum of these activities represents the total length required to complete that construction item; and

4.6.4.4.12 Additional requirements, if any, as specified in the Supplemental General Conditions and/or authorized Supplementary Conditions.

4.6.5 INTERIM COMPLETION DATES AND MILESTONES. The schedule must include contractually specified interim completion dates and milestones (which completion milestones must have a “finish on or before” soft constraint added). The milestones and completion dates indicated are considered essential to the satisfactory performance of the Contractor’s Agreement and to the coordination of all Work. The milestone dates listed are not intended to be a complete listing of all Work or of interfaces with other contractors.

4.6.6 FLOAT TIME. “Total Float” is defined as the amount of time that an activity can be delayed from its early without delaying Substantial Completion. “Free Float” is the amount of time that an activity can be delayed without delaying the early start date of any successor activity. Total Float time and Free Float time shall belong to the project and DFCM and Contractor have the right to use the Total Float time and/or Free Float Time for non-critical path activities until Contractor has reallocated such time on a newly submitted schedule.

4.6.7 UPDATES. Prior to any approval of an Application for Payment, DFCM, A/E, and Contractor shall review Contractor’s schedule compared to the Work completed. The amount of Work completed shall be approved by DFCM as supported by the schedule of values and as verified by the determination of Work completed. If necessary, Contractor shall then update and submit to DFCM the schedule with the Application for Payment; all of which shall be in accordance with DFCM’s approval. All updates shall be provided in electronic and hard copy formats. At each scheduled meeting with DFCM, Contractor shall provide a four week look ahead, with long lead items identified. If the Work is not on schedule, Contractor shall immediately advise DFCM in writing of Contractor’s proposed action to bring it on schedule.

4.6.8 SCHEDULE OF SUBMITTALS. Contractor shall prepare and keep current, for the A/E’s and DFCM’s review and approval, a schedule of submittals required by the Contract Documents, which shall be coordinated with Contractor’s construction schedule and allow the A/E a reasonable time to review the submittals. The submittal schedule shall be included as part of the construction schedule. Submittals requiring expedited review must be clearly identified as such in the schedule of submittals. Contractor shall coordinate and agree upon a submittal schedule with A/E. If a submittal does not pass a second review, then a meeting will be held to determine a path to proceed and expedite approval. Contractor shall notify A/E in writing if expedited review of a submittal is critical.

4.6.9 SCHEDULE RECOVERY. If the Work represented on the critical path falls behind more than seven (7) days, Contractor shall redo the schedule within seven (7) days, showing how the Contractor shall recover the time. Contractor’s schedule must have an approved baseline schedule before the schedule may be updated. A narrative that addresses the changes in the schedule from the previously submitted schedule shall be submitted along with the updated schedule in electronic .pdf format and on the written request of DFCM in native electronic copy format of the scheduling software utilized by Contractor. Contractor shall comply with the most recent schedules.

4.6.10 SCHEDULE CHANGES.

4.6.10.1 The Contract Time may only be shortened or extended by a Change Order or Construction Change Directive.

4.6.10.2 Should Contractor, after approval of the complete detailed construction schedule, desire to change Contractor's plan of construction, Contractor shall submit its requested revisions to DFCM and the A/E, along with a written statement of the revisions including a description of the sequence and duration changes for rescheduling the Work, methods of maintaining adherence to intermediate milestones and the completion dates, and the reasons for the revisions. Requested changes to the approved baseline schedule shall include a narrative that addresses the requested changes. If the requested changes are acceptable to DFCM, which acceptance shall not be unreasonably withheld, they shall be incorporated into the schedule in the next reporting period by Contractor. If after Contractor submits a request for change in the schedule, DFCM does not agree with the request, DFCM shall schedule a meeting with Contractor to discuss the differences.

4.6.10.3 The critical path schedule, as the term is used in these General Conditions, shall be based on the current version of Contractor's schedule for the Work and accepted by DFCM just prior to the an asserted change in the Work, asserted delay, suspension, or interruption. If Contractor believes it is entitled to an extension of Contract Time under the Contract Documents, Contractor shall submit a PCO in accordance with Section 7.2 to the A/E and DFCM accompanied by an analysis ("Requested Time Adjustment Schedule") in accordance with the Contract Documents for time extensions. The "Requested Time Adjustment Schedule" shall include "fragnets" that represent the added or changed Work to the schedule. The impact on unchanged activities caused by the changes and/or delays being analyzed shall be included in these fragnets. A "fragnet" as used in these General Conditions and when used in the context of project scheduling is a subset of project activities that are inter-related by predecessor and successor relationships that are tied into the main schedule with identified start and completion points. Each fragnet may or may not be on the critical path. An entire schedule consists of a series of inter-related fragnets.

4.6.11 EXCUSABLE DELAY.

4.6.11.1 If Contractor is unreasonably delayed in the progress of the Work on the critical path schedule by an act or neglect of DFCM; or separate contractors retained by DFCM; or by a Force Majeure Delay (defined below) that DFCM reasonably determines may justify delay beyond the date for Substantial Completion, then the Contract Time shall be extended by Change Order for the period of time caused by such delay. The Contract Price shall not be increased, and the Contract Time shall not be extended for any delays that are concurrent with Contractor delays.

4.6.11.1.1 For purposes of the Contractor's Agreement, a Force Majeure Delay shall mean a delay to the commencement or the progress of the Work by reason of events or causes beyond the control of DFCM, the Contractor, and the Contractor's Subcontractors and Sub-subcontractors of any tier, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable. Notwithstanding anything to the contrary set forth herein, Force Majeure Delays shall not include: (1) labor disputes confined to the Work site or relating solely to the Work that are due to a breach of a collective bargaining agreement by the Contractor or its Subcontractors or Sub-subcontractors of any tier, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable; (2) adverse weather conditions, except as provided in Section 4.6.11.2; (3) a failure of the Contractor or its Subcontractors or Sub-subcontractors of any tier, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable, to comply with any laws, codes or orders of governmental authorities with jurisdiction of the Work; or (4) any financial inability of the Contractor or its Subcontractors or Sub-subcontractors of any tier, or anyone directly or indirectly employed by them, to perform their obligations under the Contract Documents.

4.6.11.1.2 Delays which according to the schedule do not affect any critical path milestone dates or the completion dates shown on the schedule at the time of the delay shall not be the basis for a change in the Contract Time.

4.6.11.1.3 Contractor shall immediately take all steps reasonably possible to lessen the adverse impact of delay. Notwithstanding the foregoing, to the extent any of the causes for delay were caused by Contractor, reasonably foreseeable by Contractor, or avoidable by Contractor, then to such extent the delay shall not be cause for a change in the Contract Price and/or Contract Time. For purposes of this Section, "Contractor" shall include all Subcontractors and others under the responsibility of the Contractor.

4.6.11.1.4 The determination of the total amount of time extension, if any, shall be based upon the current schedule in effect at the inception of the change and/or delay and upon all data relevant to the extension as supported by appropriate substantiating relative data in the project record. Once approved, such data shall be incorporated in the next monthly update of the schedule by Contractor.

4.6.11.2 The Contract Price shall not be increased and the Contract Time shall not be extended for normal bad weather or any weather that is reasonably foreseeable at the time of entering into the Contractor's Agreement. The Contract Time as stated in the Contract Documents includes due allowance for days on which Work cannot be performed out of doors. Contractor acknowledges that Contractor may lose days due to weather conditions. The Contract Time may be extended at no cost to DFCM if all of the following are met, which must be established by Contractor:

4.6.11.2.1 That the weather prevented Work from occurring that is on the critical path for the Work based upon a critical path schedule previously submitted to DFCM and to the extent accepted by DFCM;

4.6.11.2.2 There are no concurrent delays for which Contractor is responsible;

4.6.11.2.3 Contractor took all reasonable steps to alleviate the impact of the weather and made reasonable attempts to prevent the delay and despite such reasonable actions of Contractor, the weather impacted the critical path as described above; and

4.6.11.2.4 In connection with the weather event for which delay is claimed by Contractor, the weather was either exceptionally adverse, such as a tornado, severe wind storm, or severe hail storm, or one of the following occurred:

4.6.11.2.4.1 for any day between November 1 and March 31 for which delay is claimed by Contractor, the recorded minimum temperature at the Work site, as verifiably documented by Contractor, fell below the mean minimum temperature for the station closest to the Work site ("Proximate Station") for the applicable month according to the Western Regional Climate Center Website, <http://www.wrcc.dri.edu/summary> ("WRCCW"), as shown on the *Average of Minimum Temperature* chart on the WRCCW for the Proximate Station, less the mean extreme minimum temperature for the Proximate Station for the applicable month, as shown on the *Minimum of Minimum Temperature Chart* on the WRCCW for the Proximate Station, divided by Two (2);

4.6.11.2.4.2 for any day between November 1 and March 31 for which delay is claimed by Contractor, the recorded maximum temperature at the Work site, as verifiably documented by Contractor, fell below the mean minimum temperature as shown on the *Average of Minimum Temperature* chart on the WRCCW for the Proximate Station;

4.6.11.2.4.3 for any day for which delay is claimed by Contractor, the recorded precipitation at the Work site, as verifiably documented by Contractor, exceeded seventy-five percent (75%) of the daily extreme for the applicable month as shown on the *POR – Daily Precipitation Average and Extreme* chart on the WRCCW for the Proximate Station;

4.6.11.2.4.4 for any day for which delay is claimed by Contractor, the recorded snowfall at the Work site, as verifiably documented by Contractor, exceeded seventy-five percent (75%) of the daily extreme for the applicable month as shown on the *POR – Daily Snowfall Average and Extreme* chart on the WRCCW for the Proximate Station.

4.6.12 COMPENSABLE DELAY, SUSPENSION OR INTERRUPTION.

4.6.12.1 In addition to the other requirements of the Contract Documents, a compensable delay, suspension, or interruption of the Work occurs only when the following conditions are met:

4.6.12.1.1 The delay is caused by DFCM for a reason not permitted by the Contract Documents; and

4.6.12.1.2 Contractor delivers a written notice to the A/E and DFCM within seven (7) days that Contractor knows or should have known of the condition giving rise to the purported compensable delay, suspension, or interruption, and the condition affects the Contract Time as indicated by the last agreed upon critical path schedule.

4.6.12.2 To the extent of the compensable delay, Contractor's total entitlement for all compensable delay damages is the computed result of the following formula: Contract Price divided by Contract Time (in calendar days); the result of which is then multiplied by 0.05; and the result of which is multiplied by the number of calendar days of compensable days allowed under these General Conditions that are beyond the Contract Time. Notwithstanding any other provision of these General Conditions or the Contract Documents, to the extent Contractor is entitled to receive a markup under Sections 7.4.2.5.1 or 7.4.2.5.2 this provision shall be inapplicable, and the markup shall be deemed to include all the compensable delay damages provided by this Section.

4.6.12.3 The length and extent of compensable delay shall be determined, with the use of the Work's critical path schedule by ascertaining the number of additional days added to the Contract Time are needed in order to perform the Work in accordance with the Contract Documents as a result of the delay, suspension, or interruption after receipt of the written notice received by the A/E and DFCM under Section 4.6.12.1.2.

4.6.12.4 Notwithstanding any other provision of these General Conditions, to the extent a non-compensable delay occurs at the same time as a compensable delay, DFCM shall not be responsible for any compensation to Contractor and the Contract Price shall not be increased for the period of the non-compensable delay.

4.6.13 **TIME EXTENSION REQUESTS.** Contractor shall notify DFCM within seven (7) days of a potential delay and Contractor shall request any and all Contract Time extensions within twenty-one (21) days after Contractor knew or should have known about the delay. Contractor must support any request for a Contract Time extension with a critical path schedule analysis.

4.6.14 LIQUIDATED DAMAGES.

4.6.14.1 Time is of the essence in the Contract Documents. DFCM will suffer damages that are difficult to ascertain for each calendar day the date for Substantial Completion is delayed. Therefore, as agreed damages and not as a penalty, DFCM may offset from any payments due Contractor the sum stated in the Contractor's Agreement, as augmented in Section 4.6.14.2 in the case of continuing delay, for each day Substantial Completion is delayed beyond the date established for Substantial Completion of the Work by the Contract Documents.

4.6.14.2 For each day subsequent to the fourteenth (14th) day after the date established for Substantial Completion of the Work by the Contract Documents, the liquidated damages amount stated in the Contractor's

Agreement shall be increased by ½ percent (0.5%) of the amount stated in the Contractor's Agreement for each day Substantial Completion is delayed beyond the date established for Substantial Completion of the Work by the Contract Documents.

4.6.14.3 The sum for liquidated damages due DFCM by Contractor has been agreed upon by reason of the inconvenience and added costs of administration, engineering, supervision, and other expenses resulting from Contractor's default.

4.6.14.4 To the extent liquidated damages exceed any amounts that would otherwise be due Contractor, Contractor shall be liable for such excess to DFCM.

4.6.14.5 Notwithstanding any other provision of these General Conditions, the availability of liquidated damages to DFCM shall not limit DFCM's right to seek damages or other remedies available under law or equity to the extent such damages or remedies are not based upon delay.

4.6.15 NO WAIVER OF DFCM'S RIGHTS. Permitting Contractor to continue any part of the Work after the time fixed for completion or beyond any authorized extension thereof shall in no way operate as a waiver or estoppel on the part of DFCM of any of its rights under the Contract Documents, including the right to liquidated damages or any other remedies or compensation.

4.7 DOCUMENTS AND SAMPLES AT THE SITE, CERTIFYING "AS-BUILTS". Contractor shall maintain at the Work site one record copy of the Drawings, Specifications, Addenda, authorized Amendments and Modifications, in good order and marked weekly to record changes and selections made during construction, as well as approved Shop Drawings, Product Data, Samples and similar submittals. These items shall be available to the A/E and shall be delivered to the A/E for submittal to DFCM upon completion of the Work, signed by Contractor, certifying that they show complete and exact "as-built" conditions, stating sizes, kind of materials, piping, conduit locations, and similar matters. All notes of encountered or changed conditions shall be included.

4.8 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

4.8.1 NOT CONTRACT DOCUMENTS. Shop Drawings, Product Data, Samples and other submittals are not Contract Documents. The submittal shall demonstrate, for those portions of the Work for which the submittal is required, the way Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

4.8.2 PROMPTNESS. Contractor shall coordinate submittals prepared by Subcontractors and Sub-subcontractors, review, approve, and submit to the A/E, Shop Drawings, Product Data, Samples and other submittals required by the Contract Documents with reasonable promptness and according to an agreed submittal schedule in such sequence as to cause no delay in the Work, or the activities of DFCM, or separate contractors.

4.8.3 NOT PERFORM UNTIL A/E APPROVES. Contractor shall not perform any portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples, mock-ups where required or other submittals (including deferred submittals) until the applicable submittal has been approved in writing by the A/E. Contractor shall perform the Work in accordance with the approved submittals. Submittals marked "No-exceptions taken" or its equivalent by the A/E are considered approved for purposes of this Section 4.8.3.

4.8.4 REPRESENTATIONS BY CONTRACTOR. By approving and submitting Shop Drawings, Product Data, Samples, and other submittals, Contractor represents that Contractor has determined and verified materials, field measurements, field construction criteria, manufacturer installation instructions and

procurement and delivery dates related thereto and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

4.8.5 CONTRACTOR'S LIABILITY. Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the A/E's approval of Shop Drawings, Product Data, Samples, or similar submittals unless Contractor has specifically informed the A/E in writing of such deviation at the time of the submittal and the A/E has given written approval to the specific deviation. Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or other submittals by the A/E's review and approval.

4.8.6 DIRECT SPECIFIC ATTENTION TO REVISIONS. Contractor shall direct specific attention in writing to all revisions on resubmitted Shop Drawings, Product Data, Samples, or other submittals, except those requested by the A/E and indicated on previous submittals.

4.8.7 INFORMATIONAL SUBMITTALS. Informational submittals upon which the A/E is not expected to take responsive action may be so identified in the Contract Documents.

4.8.8 PROFESSIONAL SERVICES. The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, DFCM and the A/E will specify performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed Design Professional (as that term is defined in Section 4.8.8.1 of these General Conditions), whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Each Design Professional providing such services shall carry professional errors and omissions insurance in an amount of at least Two Million Dollars (\$2,000,000.00) per claim/annual aggregate with a deductible or self-insured retention of not greater than One Hundred Thousand Dollars (\$100,000.00), unless different amounts are authorized by DFCM in writing. Shop Drawings and other submittals related to the Work designed or certified by such Design Professional, if prepared by others, shall bear such Design Professional's written approval when submitted to the A/E. DFCM and the A/E shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such Design Professional, provided DFCM and A/E have specified to the Contractor performance and design criteria that such services must satisfy. Pursuant to this Section 4.8, the A/E will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

4.8.8.1 A "Design Professional" is any and all employees or independent contractors directly or indirectly employed by the Contractor, a Subcontractor or a Sub-subcontractor of any tier to perform any professional design services required by the Contract Documents. The Contractor or its Subcontractors or Sub-subcontractors of any tier employing the Design Professional shall require the Design Professional to agree in writing to be bound by the terms of the Contract Documents insofar as they apply to the design services of the Design Professional in the performance of the Work.

4.8.8.2 The Contractor hereby assigns to DFCM all common law, statutory and other rights that the Contractor may have in the drawings, specifications and other documents prepared by the Design Professional for the Work (the "Design Documents"), including all copyrights. The Contractor shall endeavor to obtain a similar assignment to DFCM by the Design Professional and by the Subcontractors or Sub-subcontractors of

any tier employing the Design Professional of their common law, statutory and other rights (including copyrights) in the Design Documents. At the date of final payment or upon the earlier termination of the Contractor's Agreement, the Contractor shall promptly deliver to DFCM hardcopy originals of all Design Documents and all Design Documents in reproducible (not read only) electronic media.

4.8.8.3 The Contractor shall require and hereby represents and warrants to DFCM that the Design Professional is appropriately registered with and licensed by the State of Utah to perform the services required by the Contract Documents to be performed by the Design Professional.

4.8.8.4 All services provided by the Design Professional shall be performed consistent with the professional skill and care ordinarily provided by other design professionals: (1) with the same or similar license; and (2) providing the same or similar design professional service (A) in the same or similar locality, (B) at the same or similar time and (C) under the same or similar circumstances, provided that, if the nature of the project reasonably requires specialized design expertise, the Design Professional shall perform design professional services consistent with such specialized design expertise.

4.8.8.5 Notwithstanding any approval of DFCM or A/E of any Design Documents, the Contractor shall be responsible for assuring that all Design Documents (whether prepared by a Design Professional employed by the Contractor, a Subcontractor or a Sub-subcontractor of any tier) are technically adequate and accurate and are in accordance with all laws, ordinances, codes, regulations or other requirements of governmental authorities having jurisdiction of the Work applicable to the Work on the day of the issuance of such documents and on the day of the use of such documents on the Work.

4.8.8.6 The Contractor shall be responsible and liable to DFCM for any and all losses, costs, and/or expenses incurred by DFCM arising out of, related to and/or connected with errors or omissions in the services provided hereunder by the Design Professional, to the extent that such errors or omissions were caused by the failure of the Design Professional to perform services consistent with the requirements of Section 4.8.8.4 or by other fault of the Design Professional, whether or not such losses, costs and/or expenses were caused by any negligence or other fault of the Contractor. This responsibility and liability shall survive completion of the Work or termination of the Contractor's Agreement.

4.8.8.7 The Contractor shall indemnify and hold harmless DFCM and the other Indemnified Parties (as defined in Section 4.12) from and against any and all third-party claims, demands, losses, liabilities, judgments, costs, expenses and/or attorney fees arising of, related to and/or connected with errors or omissions in the services provided hereunder by the Design Professional, to the extent that such errors or omissions were caused by the failure of the Design Professional to perform services consistent with the requirements of Section 4.8.8.4 or by other fault of the Design Professional, whether or not such third-party claims, demands, losses, liabilities, judgments, costs, expenses and/or attorney fees were caused by any negligence or other fault of the Contractor. This indemnity is in addition to the indemnity provided in Section 4.12 and shall survive completion of the Work or termination of the Contractor's Agreement.

4.8.8.8 The Contractor's or its Subcontractor's or Sub-subcontractor of any tier's agreement with the Design Professional for design services in the performance of the Work shall state that DFCM and its successors and assigns are intended third-party beneficiaries of such agreement and such agreement with the Design Professional shall require the Design Professional to deliver to DFCM a separate agreement wherein the Design Professional shall expressly contract with DFCM to provide the Design Professional's professional services consistent with the standard of care established by Section 4.8.8.4.

4.8.8.9 The Contractor shall indemnify, defend and hold harmless DFCM and the other Indemnified Parties (as defined in Section 4.12 of these General Conditions) from and against any and all claims, demands, losses, liabilities, judgments, costs, expenses and/or attorney fees caused by any suits or claims of infringement of any patent rights or copyrights for materials, methods or systems depicted upon or required by Design Documents

prepared by the Design Professional. This indemnity is in addition to the indemnity provided in Sections 4.11 and 4.12 of these General Conditions and shall survive completion of the Work or termination of the Contractor's Agreement.

4.9 USE OF SITE.

4.9.1 IN GENERAL. Contractor shall confine its equipment, the storage of materials, and the operations of its workers at the Work site to areas permitted by the Contract Documents, laws, rules, regulations, ordinances, orders, and permits and shall not unreasonably encumber the Work site with materials or equipment. Contractor shall take all reasonable steps to secure the Work site and protect the Work from any damage. Upon completion of the Work, Contractor shall leave the Work site free and clear of all waste materials, rubbish, tools, equipment, and surplus materials. Contractor shall at all times keep the Work site free from spilled liquids and chemicals, toxic or otherwise. If such a spill occurs while Contractor has control of the Work site, Contractor shall be responsible to clean the affected areas on or about the Work site and pay all associated costs, fines, and penalties. Notwithstanding the foregoing, Contractor shall not be responsible for any damage to the Work site or the Work to the extent caused by DFCM or DFCM's agents.

4.9.2 ACCESS TO NEIGHBORING PROPERTIES.

4.9.2.1 Contractor shall not, except as provided in the Contract Documents or with DFCM's advance written consent when necessary to perform the Work, interfere with access to properties neighboring the Work site by the owners of such properties and their respective tenants, agents, invitees and guests.

4.9.2.2 Various federal, state, and local agencies and private landowners may own or control lands and facilities either crossed by or adjacent to the Work site. DFCM shall secure and pay for all necessary rights of access to the Work site. Contractor shall comply with all stipulations provided by DFCM and shall maintain a cooperative relationship with all agencies and landowners. Contractor shall not retain on the Work site any person who in the judgment of DFCM prejudices or tends to endanger this cooperation. Contractor shall not enter into any agreement with such agencies or landowners related to the Work without prior approval by DFCM.

4.10 ACCESS TO WORK. Contractor shall provide DFCM and the A/E access to the Work in preparation and progress, at all times and wherever located.

4.11 INTELLECTUAL PROPERTY LICENSES. Contractor shall obtain and pay for all royalties and other license fees for all equipment, property, or processes of Contractor used or purchased in connection with performance of the Work. Contractor shall defend suits or claims for infringement of intellectual property rights and shall hold DFCM and the A/E harmless from loss on account thereof but shall not be responsible for such defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents. However, if Contractor has reason to believe that the required design, process or product is an infringement of any third party's intellectual property right, Contractor shall be responsible for such defense or loss unless such information is promptly furnished to DFCM in writing.

4.12 INDEMNIFICATION. To the fullest extent permitted by law, Contractor shall release, indemnify, hold harmless, and defend the State of Utah, the State of Utah's institutions, agencies (including, but not limited to, DFCM), departments, divisions, authorities, and instrumentalities, boards, commissions, elected or appointed officers, employees, agents and authorized volunteers (collectively "Indemnified Parties") from and against any and all claims, liabilities, demands, actions, damages, losses and expenses of any nature whatsoever, including, but not limited to, attorneys' fees and defense costs (collectively "Liabilities"), and including those events covered under the blanket Contractual Liability Coverage required under the Contract Documents, arising out of, related to, or connected with any act or omission in the performance of the Work, including the Work of all Subcontractors and their employees, provided that any Liabilities are caused in whole or in part by

the negligent, intentional, or other wrongful act or omission of Contractor, any Subcontractor, their employees, or anyone directly or indirectly employed or the agent of any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by an Indemnified Party. Without relieving Contractor of any obligation under the Contract, the Indemnified Parties shall have the right, at their option, to fully participate in the investigation, defense and settlement of any Liabilities.

4.12.1 NOT EXCLUSIVE. The foregoing obligations in this Section 4.12 shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person under the Contract Documents.

4.12.2 NOT LIMITED. The foregoing obligations in this Section 4.12 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or Subcontractor under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

ARTICLE 5. SUBCONTRACTORS.

5.1 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK.

5.1.1 SUBCONTRACTING WORK PERMITTED; CONDITIONS.

5.1.1.1 Contractor may subcontract portions of the Work.

5.1.1.2 DFCM reserves the right to reject on reasonable ground any Subcontractor. Contractor shall not contract with any person or entity to whom DFCM has made reasonable objection. Contractor shall not be required to contract with anyone to whom Contractor has made reasonable and timely objection, provided that any additional costs associated with Contractor replacing a Subcontractor objected to by Contractor with a replacement Subcontractor not objectionable to Contractor shall be at no cost to DFCM.

5.1.2 SUBSEQUENT CHANGES. After execution of Contractor's Agreement Subcontractors listed by Contractor in accordance with Utah Code § 63A-5b-605 and Rule R23-1-615 may be changed by Contractor only in accordance with the requirements of Utah Code § 63A-5b-605 and R23-1-615.

5.1.2.1 DFCM shall pay the additional costs for a DFCM-requested change in Subcontractor if all of the following conditions are met:

5.1.2.1.1 If DFCM in writing requests the change of a Subcontractor;

5.1.2.1.2 The original Subcontractor is a responsible subcontractor that meets the requirements of the Contract Documents; and

5.1.2.1.3 The original Subcontractor did not withdraw as a Subcontractor on the Work.

5.1.2.2 In all other circumstances, Contractor shall pay the additional cost for a change in a Subcontractor.

5.1.3 BUSINESS AND LICENSING REQUIREMENTS. All Subcontractors used by Contractor shall have secured, at their own expense, all necessary professional accreditations, registrations, and licenses in the state of Utah.

5.1.4 BONDING OF SUBCONTRACTORS. Subcontractors, as identified by DFCM in the procurement documents, may be required to submit performance and payment bonds to cover the full extent of

their portion of the Work. This provision does not in any way limit the right of Contractor to have Subcontractors at any tier be required to have a performance and/or payment bond at Contractor's expense.

5.1.5 SUBCONTRACTOR DEFAULT INSURANCE. If the Contract Price includes any amount to compensate the Contractor for Subcontractor Default Insurance ("SDI"), then, notwithstanding anything in the Contract Documents to the contrary:

5.1.5.1 DFCM shall be added to the SDI by a financial interest endorsement reasonably acceptable to DFCM at no cost to DFCM;

5.1.5.2 If the Contract Documents provide for Contractor contingency, no Contractor contingency may be expended for any Subcontractor default or for any expenses and/or losses arising out of, connected with and/or related to any Subcontractor default;

5.1.5.3 Contractor shall in no event be entitled to an increase in the Contract Price and/or extension of the Contract Time for a Subcontractor default or for expense, losses and/or delays arising out of, connected with and/or related in any way to a Subcontractor default; and

5.1.5.4 The cost of SDI is included in Contractor's overhead and profit for purposes of Article 7.

5.2 SUBCONTRACTUAL RELATIONS.

5.2.1 CONTRACTOR FULLY RESPONSIBLE. Subcontracting any portion of the Work shall not relieve Contractor of Contractor's obligations or duties under the Contract Documents, Contractor shall be fully responsible and liable to DFCM for the acts and omissions of all Subcontractors at any tier and their employees and agents and Contractor shall maintain complete control over all Subcontractors. Neither the consent of DFCM to a Subcontractor proposed by Contractor, nor anything contained in the Contract Documents shall be deemed to create a contractual relationship between a Subcontractor at any tier and DFCM.

5.2.2 COMPLY WITH CONTRACT DOCUMENTS. By appropriate enforceable agreement Contractor shall require each Subcontractor to be bound to Contractor by the terms of the Contract Documents, and to assume toward Contractor all the obligations and responsibilities that Contractor, by the Contract Documents, assumes towards DFCM and the A/E.

5.2.3 RIGHTS. Each Subcontractor agreement shall preserve and protect the rights of DFCM under the Contract Documents with respect to that portion of the Work to be performed by the Subcontractor so that subcontracting any portion of the Work shall not prejudice any rights of DFCM under the Contract Documents, and shall allow to the Subcontractor, unless specifically provided otherwise in the Subcontractor agreement, the benefit of all rights and remedies against Contractor that Contractor, by the Contract Documents, has against DFCM.

5.2.4 SUB-SUBCONTRACTORS. Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors and to require such Sub-subcontractors to enter into similar agreements with lower tier Sub-subcontractors that comply with the requirements of Sections 5.2.2 and 5.2.3.

5.2.5 DOCUMENT COPIES. Contractor shall make available to each proposed Subcontractor, prior to execution of the Subcontractor agreement, copies of the Contract Documents to which the Subcontractor shall be bound. Contractor shall require Subcontractors to make copies of applicable portions of the Contract Documents available to their respective proposed Sub-subcontractors.

5.3 CONTINGENT ASSIGNMENT OF SUBCONTRACTS TO DFCM. Contractor contingently assigns each Subcontractor agreement with a Subcontractor for a portion of the Work to DFCM, provided that

the assignment is effective only after termination of the Contractor's Agreement by DFCM for cause pursuant to Section 12.2 or stoppage of the Work by DFCM pursuant to Section 12.5, and only for those Subcontractor agreements that DFCM accepts by notifying the Subcontractor in writing. Contractor shall remain liable for all obligations incurred under assigned Subcontractor agreements prior to DFCM's acceptance of such assignment.

ARTICLE 6. PROTECTION OF PERSONS AND PROPERTY.

6.1 SAFETY OF PERSONS AND PROPERTY.

6.1.1 CONTRACTOR RESPONSIBILITY. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Work. Contractor shall seek to minimize the risk of bodily injury, property damage, and environmental harm by taking all reasonable precautions to protect:

6.1.1.1 All persons at and/or in proximity to the Work site;

6.1.1.2 Materials and equipment to be incorporated in the Work, whether in storage on or off the Work site, under the care, custody, or control of Contractor or a Subcontractor;

6.1.1.3 Property and structures located at the Work site and adjacent to the Work site, whether or not such property and structures are part of the Work, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction; and

6.1.1.4 The environment.

6.1.2 SAFETY PROGRAM, PRECAUTIONS. Contractor shall institute and provide to DFCM a project specific safety program at the start of the Work to minimize accidents. The program shall continue to the final completion of the Work and conform to applicable laws, rules, and regulations. including without limitation. the Utah Occupational Safety and Health Rules as published by the Utah Labor Commission - UOSH Division at Utah Administrative Code, R614. Contractor shall post signs, erect barriers, and provide those items necessary to implement the safety program. As soon as Contractor proceeds with the Work, Contractor shall have all workers and all visitors on the Work site wear safety hard hats, as well as all other appropriate safety apparel such as safety glasses and shoes, and obey all safety laws, rules, and regulations. Contractor shall post a sign in a conspicuous location indicating the necessity of wearing hard hats, and Contractor shall loan such hard hats to visitors. Contractor shall maintain a clean and orderly Work site.

6.1.3 COMPLIANCE WITH LAWS. Contractor shall give notices and comply with applicable laws, rules, regulations, ordinances, and orders of public authorities applicable to the safety of persons and property and their protection from damage, injury and loss. In particular, Contractor shall comply with all applicable provisions of federal, state and municipal safety laws, rules and regulations, specifically including, without limitation, building codes, to prevent accidents and injury to persons on, about or adjacent to the Work site.

6.1.4 ERECT AND MAINTAIN SAFEGUARDS. As required by existing conditions at the Work site and proper and safe performance of the Work, Contractor shall erect and maintain safeguards for safety and protection, including effective fences, danger signs, barricades and other warnings against hazards. Contractor shall also promulgate safety regulations and notify owners and users of adjacent sites and/or utilities before performing Work that may impact such adjacent sites and/or utilities.

6.1.5 UTMOST CARE. When use or storage of explosives or other dangerous materials or equipment or unusual methods are necessary for execution of the Work, Contractor shall exercise utmost care and carry on such activities under the supervision of properly qualified personnel.

6.1.6 PROMPT REMEDY. Contractor shall promptly remedy any damage and loss (other than damage or loss insured under property insurance required by Section 10.2) to persons, property and/or the environment arising in conjunction with the Work caused in whole or in part by Contractor, Subcontractors, or any person or entity for whose acts Contractor is responsible, without cost or expense to DFCM.

6.1.7 SAFETY DESIGNEE. Contractor shall designate a responsible member of Contractor's organization at the Work site whose duty shall be the prevention of accidents, damage, injury and loss. This person shall be Contractor's superintendent, unless otherwise designated by Contractor in writing to DFCM and the A/E.

6.1.8 LOAD SAFETY. Contractor shall not load or permit any part of the construction or Work site to be loaded so as to endanger its safety and/or the safety of persons at or in the vicinity of the Work site.

6.1.9 OFF-SITE RESPONSIBILITY. In addition to its other obligations under this Article 6, the Contractor shall, at Contractor's sole cost and expense, promptly repair any damage or disturbance to walls, utilities, streets, ways, sidewalks, curbs and the property of the State and third parties (including municipalities and other governmental agencies) resulting from the performance of the Work, whether by Contractor or by Contractor's Subcontractors at any tier. The Contractor shall not cause materials, including soil and debris, to be placed or left on streets or ways.

6.1.10 EMERGENCIES. In an emergency affecting safety of persons or property, Contractor shall act, at Contractor's discretion, to prevent threatened damage, injury or loss. Contractor shall promptly notify DFCM of the action taken.

6.2 HAZARDOUS MATERIALS. In the event Contractor encounters at the Work site material reasonably believed to be asbestos, polychlorinated biphenyl (PCB), or any other hazardous waste or substance that may endanger the health of persons performing Work or being at the Work site that is not part of the Work and/or disclosed by the Contract Documents, Contractor shall immediately stop Work in the area affected and immediately report the condition to DFCM and the A/E by phone with a follow-up email. Contractor shall resume the Work in the affected area upon written direction provided by DFCM. Except to the extent provided otherwise in the Contract Documents, or if the presence of hazardous materials is due to the fault of Contractor, Contractor shall not be required to perform, without Contractor's consent, any Work relating to asbestos, polychlorinated biphenyl (PCB), or any other hazardous waste or substance.

6.3 HISTORICAL AND ARCHEOLOGICAL CONSIDERATIONS. In the event Contractor discovers any cultural, historical, or archeological material that is either recognized as an item to be protected under federal, state, or local law or regulation, or is an item of obvious value to the State of Utah, Contractor shall cease any Work that would interfere with such discovery and immediately report the condition to DFCM and the A/E by phone with a follow-up email. Contractor shall resume the Work upon the direction of DFCM. Contractor shall ensure cooperation with any DFCM-recognized archaeologist or other cultural/historical expert.

6.4 CONTRACTOR LIABILITY. If Contractor fails in any of its obligations in Sections 6.2 through 6.3, Contractor shall be liable for any damages to DFCM, the State of Utah, or any third party resulting from such noncompliance. Contractor shall also be liable for any mitigation or restoration effort resulting from such noncompliance. To the extent all the following is met, the presence of hazardous material or cultural, historical, or archeological material at the Work site shall qualify as a concealed or unforeseen condition under Section 7.1.5:

6.4.1 The presence of such material is not reasonably foreseeable given the site conditions that Contractor is or should have been aware of;

- 6.4.2** The presence of such material is not identified in any part of the Contract Documents;
- 6.4.3** Contractor has undertaken all proper action to mitigate any impact of the discovery of such material on the Contract Time and/or Contract Price;
- 6.4.4** The discovery of such material increases the Contract Time and/or Contract Price from what is stated in the Contract Documents; and
- 6.4.5** The requirements of Section 7.1.5 and the Contract Documents are met.

ARTICLE 7. MODIFICATIONS, PRs & PCOs, PRE AND CLAIM PROCESS.

7.1 MODIFICATIONS: IN GENERAL.

7.1.1 TYPES OF MODIFICATIONS AND LIMITATIONS. Changes in the Work may be accomplished after execution of the Contractor's Agreement, and without invalidating the Contract Documents, by ASI, Change Order or Construction Change Directive, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents. Contractor must have a written Change Order or Construction Change Directive executed by DFCM under this Article 7 prior to proceeding with any Work for which Contractor intends to request an increase in the Contract Price and/or an extension of the Contract Time.

7.1.2 BY WHOM ISSUED. The A/E or DFCM may issue ASIs not involving an adjustment in the Contract Price or an extension of the Contract Time which are not inconsistent with the intent of the Contract Documents. A Change Order or Construction Change Directive shall be issued by DFCM. The A/E shall prepare Change Orders and Construction Change Directives with specific documentation and data for DFCM's approval and execution in accordance with the Contract Documents.

7.1.3 CONTRACTOR TO PROCEED UNLESS OTHERWISE STATED. Changes in the Work shall be performed under applicable provisions of the Contract Documents, and Contractor shall proceed promptly, unless otherwise provided in the ASI, Change Order or Construction Change Directive.

7.1.4 ADJUSTING UNIT PRICES. If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a proposed Change Order or Construction Change Directive that application of such unit prices to quantities of Work proposed shall cause a substantial inequity to DFCM or Contractor, the applicable unit prices may be equitably adjusted.

7.1.5 CONCEALED OR UNKNOWN CONDITIONS. Contractor must file a written notice with DFCM within seven (7) calendar days of the date that Contractor knew or should have known of a site condition described below or Contractor shall be deemed to waive any right to file any PCO, PRE, or Claim for an increase in the Contract Price and/or extension of the Contract Time related to such condition:

7.1.5.1 If Contractor encounters unknown and reasonably unforeseeable subsurface or otherwise concealed physical conditions, including hazardous or historical/cultural/archeological materials under Article 6, which differ materially from those indicated by the Contract Documents or which would have been revealed by a reasonably thorough site inspection; or

7.1.5.2 If Contractor encounters unknown physical conditions of an unusual nature which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents.

7.1.6 INCREASE IN CONTRACT TIME. To the extent DFCM and/or the State of Utah is damaged by the failure of Contractor to provide the notice required by Section 7.1.5 after the Contractor knows or should

have known of such site condition, Contractor shall be liable for liquidated damages attributable thereto, as well as any damages to the State of Utah and/or DFCM that are allowable in addition to liquidated damages.

7.1.7 ALLOWANCES.

7.1.7.1 The Contractor has included in the Contract Price all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as DFCM may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

7.1.7.2 Unless otherwise provided in the Contract Documents:

7.1.7.2.1 Allowances shall cover the cost to the Contractor of materials and equipment delivered at the Work site and all required taxes, less applicable trade discounts;

7.1.7.2.2 Allowances shall cover the Contractor's costs of unloading and handling at the Work site, labor, installation costs and other expenses contemplated for allowance items of the Work, including the Contractor's overhead and profit.

7.1.7.2.3 Whenever costs are more than or less than allowances, the Contract Price for the Work shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 7.1.7.2.1 and (2) changes in Contractor's costs under Section 7.1.7.2.2.

7.1.7.3 Materials and equipment under an allowance shall be selected by DFCM with reasonable promptness.

7.2 CONTRACTOR INITIATED REQUESTS.

7.2.1 THE REQUEST FOR INFORMATION ("RFI") PROCESS AND TIME TO FILE. Contractor may file an RFI with the A/E regarding any question the answer to which will assist Contractor in the proper completion of the Work, including, but not limited to, issues related to the Contract Documents, Drawings, and Specifications. The RFI shall be filed with the A/E in a timely manner so as not to prejudice DFCM as to the quality, time, or cost related to the Work.

7.2.2 PROPOSED CHANGE ORDER ("PCO"). Within seven (7) days after Contractor knows or should know of a situation or condition for which Contractor anticipates requesting an increase in the Contract Price and/or extension of the Contract Time, Contractor must file a Proposed Change Order ("PCO") with DFCM, or Contractor shall be deemed to waive any right to claim an increase in the Contract Price and/or extension of the Contract Time related to such situation or condition. The PCO shall include all documentation supporting the PCO available to Contractor at the time of filing and Contractor shall thereafter diligently pursue the supplementation(s) of such documentation and promptly deliver such supplementation(s) to DFCM.

7.2.2.1 One of the following may occur after a PCO is filed with DFCM:

7.2.2.1.1 DFCM, after considering any input by the A/E, may reach an agreement with Contractor and issue a Change Order.

7.2.2.1.2 DFCM, after considering any input by the A/E, may issue a Construction Change Directive.

7.2.2.1.3 If DFCM, after considering any input by the A/E, disagrees with Contractor's PCO, DFCM may seek additional information or verification from Contractor, the A/E, or other sources, and may negotiate with

Contractor, may issue a Change Order upon such later agreement, may issue or retract an issued PR, or may issue a Construction Change Directive.

7.2.2.2 If a Construction Change Directive is issued which identifies DFCM's position in regard to a Contract Price and/or Contract Time adjustment or if a PCO is denied by DFCM, Contractor must file a PRE no later than twenty-one (21) days after Contractor's receipt of the Construction Change Directive or such denial of the PCO. Failure to timely file a PRE shall be deemed to waive any right to an increase in the Contract Price and/or extension of the Contract Time related to a Construction Change Directive beyond that identified by DFCM in the Construction Change Directive, if any, or denial of the PCO. Such waiver shall entitle DFCM to convert a Construction Change Directive into a Change Order, whether or not executed by Contractor.

7.2.2.3 If a Construction Change Directive leaves open the determination of an increase in the Contract Price and/or extension of the Contract Time related to a change in the Work, then the time period for commencement of filing the PRE shall not accrue until such time as DFCM has conveyed to Contractor DFCM's position as to increase, if any, in the Contract Price and/or extension, if any, of the Contract Time as a result of the change in the Work.

7.2.2.4 The Contractor must continually cooperate with DFCM in providing data, documentation and efforts to resolve any issues related to a PCO.

7.2.3 **SUBSTITUTIONS.** The Contractor may make substitutions only with the consent of DFCM, after evaluation by the A/E and in accordance with a Change Order. Substitutions will be considered after the award of the Contractor's Agreement only when a PCO is submitted by the Contractor to substitute a non-specified product for a product specified in the Contract Documents, under the following conditions:

7.2.3.1 The PCO is accompanied by complete data on the proposed substitution substantiating compliance with the design intent and performance requirements of the Contract Documents, including product identification and description, performance and test data, references and samples where applicable, comparison of the proposed substitution with the products specified or named in the Contract Documents, and the impact of the substitution upon the Contract Time.

7.2.3.2. The PCO is accompanied by accurate cost data on the proposed substitution and comparison with the products specified, whether or not modification of the Contract Price is to be a consideration.

7.2.3.3 The Contractor is responsible for any additional costs for the A/E's additional services caused by the evaluation of the proposed substitution and/or the substitution of products.

7.2.3.4 The PCO for substitution by the Contractor shall constitute a certification by the Contractor that the Contractor has investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified; the cost data presented by the Contractor is complete and includes all related costs under the Contract Documents, including the A/E's additional services; the Contractor waives all claims for additional costs related to the substitution which subsequently become apparent; the Contractor will provide the same guarantee or warranty for the substituted product that the Contractor would have provided for the product specified in the Contract Documents; and the Contractor will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be properly completed in all respects.

7.2.3.5 Substitutions will not be considered by the A/E or DFCM if they are intended or implied by submittals of Shop Drawings, Product Data or Samples without a PCO for substitution or when for their implementation they require a substantial revision of the Contract Documents in order to accommodate their use.

7.3 PROPOSAL REQUEST INITIATED BY DFCM. DFCM may submit a Proposal Request to Contractor seeking information, data, impact on the Contract Price and/or impact on the Contract Time for a change in the Work or other modification to the Contract Documents. The PR shall provide a time limit for Contractor to file a response with the A/E and DFCM. If a proposal is not timely provided by Contractor, DFCM may calculate a Change Order under Section 7.4.2. Upon timely receipt of a proposal, one of the following shall occur:

7.3.1 IF AGREEMENT, CHANGE ORDER ISSUED. DFCM, after considering any input by the A/E, may reach an agreement with the Contractor and issue a Change Order.

7.3.2 IF DISAGREEMENT. If DFCM disagrees with Contractor's proposal, after considering any input from the A/E, DFCM may seek additional information or verification from Contractor or other sources, may negotiate with Contractor, may issue a Change Order upon such later agreement, may retract the PR, or may issue a Construction Change Directive. If a Construction Change Directive is issued that identifies DFCM's position in regard to the increase, if any in the Contract Price and/or extension, if any, of the Contract Time, Contractor must file a PRE within twenty-one (21) days of Contractor's receipt of the Construction Change Directive, or Contractor shall be deemed to waive any right for an increase in the Contract Price and/or extension of the Contract Time as a result of the issuance of the Construction Change Directive beyond that identified by DFCM in the Construction Change Directive, if any. Such waiver shall entitle DFCM to convert the Construction Change Directive into a Change Order, whether or not executed by Contractor. If the Construction Change Directive leaves open the determination of an increase, if any, in the Contract Price and/or extension, if any, of the Contract Time related to the change in the Work, then the time period for commencement of filing the PRE shall not accrue until such time as DFCM has conveyed to Contractor DFCM's position as to the increase, if any, in the Contract Price and/or extension, if any, of the Contract Time resulting from the change in the Work.

7.4 CHANGE ORDERS.

7.4.1 ADJUSTING PRICE BASED UPON AGREEMENT. If a Change Order provides for an adjustment to the Contract Price, the adjustment shall be based on the mutual agreement of Contractor and DFCM, including any terms mandated by unit price agreements or other terms of the Contract Documents.

7.4.2 DFCM RESOLUTION OF PRICE IN THE ABSENCE OF AN AGREEMENT UNDER SECTION 7.4.1. In the absence of an agreement under Section 7.4.1, the adjustment in Contract Price shall be based on an itemized accounting of costs and savings supported by appropriate data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section shall be limited to the following:

7.4.2.1 All direct and indirect costs of labor; including workers' compensation insurance, social security, and other federal and state payroll-based taxes, and payroll-based fringe benefits paid by Contractor so long as they are reasonable and no higher than that charged to other clients;

7.4.2.2 Costs of materials, on-site temporary facilities, supplies, and equipment (except hand tools) required for or incorporated into the Work;

7.4.2.3 Rental costs of machinery, equipment, tools (except hand tools), and on-site temporary facilities, whether rented from Contractor or others;

7.4.2.4 Costs of permits and other fees, sales, use or similar taxes related to the Work; and

7.4.2.5 Overhead and profit. The markups stated herein for overhead and profit are intended to cover the Contractor's profit and all indirect costs associated with a change in the Work. Items covered by such markups include, but are not limited to: home office expenses, branch office and field office overhead expense of any

kind; project management; estimating, engineering; coordinating; expediting; purchasing; billing and invoicing; detailing; legal, accounting, data processing or other administrative expenses; computer and telephone costs (including computer and phone allowances); shop drawings; liability insurance premium, auto insurance premium, performance and payment bond premium and SDI; vehicle costs (including vehicle allowances); ESOP related costs; and warranty expense costs. The cost for the use of small tools is also to be considered covered by such markups. Small tools shall be defined as tools and equipment (power or non-power) with an individual purchase cost of less than Seven Hundred Fifty Dollars (\$750).

7.4.2.5.1 The maximum markup percentage to be paid to any contractor (regardless of tier) including Contractor, a Subcontractor and/or Sub-subcontractor on self-performed work shall be a single markup percentage not-to-exceed fifteen percent (15%) of the net increased direct cost of: (A) direct labor and allowable labor burden costs applicable to the change in the Work; (B) the net cost of material and installed equipment incorporated into the change in the Work, and (C) net rental cost of major equipment and related fuel costs necessary to complete the change in the Work;

7.4.2.5.2 With respect to pricing the portion of Change Orders involving work performed by lower tier contractors, including Subcontractors and Sub-subcontractors, the maximum markup percentage allowable to the Contractor, Subcontractor or Sub-subcontractor supervising the lower tier contractor's work shall not exceed seven percent (7%) of the net increase of all approved changes in the Work performed by all contractors combined for any particular Change Order.

7.4.2.5.3 Contractor agrees to include these limitations on Change Order pricing in Contractor's subcontracts with Subcontractors and shall likewise require all of Contractor's Subcontractors to include the same provisions in all sub-subcontracts with their respective Sub-subcontractors of any tier.

7.4.3 CREDITS. The amount of credit to be allowed by Contractor to DFCM for a deletion or change in the Work which results in a net decrease in the Contract Price shall be actual net cost as confirmed to DFCM based upon corroboration by an appropriate source, provided, however, the application of the markup percentages referenced in Section 7.4.2.5 for overhead and profit will apply only to additive change orders. In those instances where a change in the Work involves both additive and deductive work, the additions and deductions will be netted and the markup percentage adjustments will be applied to the net additive amount, if any.

7.4.4 EFFECT OF A CHANGE ORDER. A Change Order signed by the Contractor constitutes the Contractor's agreement that, when implemented by DFCM, the adjustment in the Contract Price, if any, and/or the adjustment in the Contract Time, if any, for the change in the Work shall fully and finally compensate the Contractor and its Subcontractors and Sub-subcontractors of any tier for any and all additional costs, damages or expenses arising directly or indirectly out of the change in the Work described in the Change Order.

7.4.4.1 All Change Orders shall be conclusively presumed to constitute settlement of all Claims for direct or indirect damages of the Contractor, its Subcontractors and their respective Sub-subcontractors of any tier arising out of the change in the Work. This shall include, but is not limited to, any and all so-called "delay," "equitable adjustment," "impact," "cumulative impact," "acceleration," "constructive acceleration," "inefficiency," "interference," "indirect," "ripple" or "consequential" claims, costs or damages and all direct or indirect costs pertaining to the Contractor's home office, branch offices, or field site office and all other costs and effects whatsoever relating to the change in the Work.

7.4.4.2 Any statement unilaterally added by the Contractor to a Change Order or contained in any transmittal or separate correspondence wherein the Contractor unilaterally attempts to reserve rights to seek any further increases in the Contract Price and/or further extensions of the Contract Time for a change in the Work that is the subject of the Change Order and/or arising out of, related to and/or connected with the change in the Work described in the Change Order shall be null and void.

7.5 CONSTRUCTION CHANGE DIRECTIVES.

7.5.1 WHEN USED AND CONTRACTOR'S RIGHT TO CHALLENGE. Without invalidating the Contractor's Agreement, DFCM reserves the right to unilaterally issue, in DFCM's sole discretion, a Construction Change Directive that requires Contractor to proceed with a change in the Work. DFCM may order minor changes within the scope of Work without granting an adjustment in the Contract Price or an extension of the Contract Time if such minor changes within the scope of Work are consistent with the intent of the Contract Documents. In order to expedite the Work and avoid or minimize delays in the Work that may affect the Contract Price or Contract Time, the Contract Documents shall be amended as described below. If the Construction Change Directive leaves open the determination of an increase, if any, in the Contract Price and/or extension, if any, of the Contract Time related to the change in the Work, then the Construction Change Directive shall indicate the timeframe(s) in which Contractor shall provide further information to resolve such open issue(s). When DFCM and Contractor agree upon an increase, if any, in the Contract Price and/or extension, if any, in the Contract Time related to a Construction Change Directive, the parties shall execute a Change Order. Additionally, the Construction Change Directive may be converted to a Change Order under Section 7.2.2.2 or Section 7.3.2.

7.5.2 PROCEED WITH WORK. Upon receipt of a Construction Change Directive, Contractor shall promptly proceed with the change in the Work involved.

7.5.3 INTERIM PAYMENTS BY DFCM. Pending the final determination of the increase in the Contract Price, if any, associated with a Construction Change Directive, DFCM shall pay any undisputed amount to Contractor.

7.6 ASI. The A/E may at any time that is consistent with maintaining the quality, safety, time, budget, and function of the Work, issue to Contractor an ASI after approval from DFCM is obtained.

7.7 PROCEDURE FOR PRELIMINARY RESOLUTION EFFORTS.

7.7.1 REQUEST FOR PRELIMINARY RESOLUTION EFFORT (PRE). If Contractor wishes to raise an issue related to an alleged breach of contract by DFCM or an issue concerning time or money, Contractor shall file a PRE as a prerequisite for any consideration of the issue by DFCM. The labeling of the notice or request shall not preclude the consideration of the issue by DFCM.

7.7.2 TIME FOR FILING. The PRE must be filed in writing with DFCM within twenty-one (21) days of any of the following:

7.7.2.1 Issuance of a Construction Change Directive that states the adjustment in Contract Price and/or Contract Time, if any, if Contractor disagrees with such adjustment;

7.7.2.2 Issuance of a statement of DFCM's position with respect to the adjustment in Contract Price and/or Contract Time, if any, in a previously issued Construction Change Directive that left open the adjustment in Contract Price and/or Contract Time, if Contractor disagrees with such statement;

7.7.2.3 Issuance of a denial of a PCO by DFCM;

7.7.2.4 In the case of a Subcontractor, after the expiration of the time period for the Contractor/Subcontractor PRE process under Section 7.7.5; or

7.7.2.5 Except as provided in Section 7.2.2, when Contractor knows or should have known about any other issue where Contractor seeks an adjustment in the Contract Price, Contract Time and/or other relief from DFCM.

7.7.3 CONTENT REQUIREMENT. The PRE shall be required to include in writing to the extent information is reasonably available at the time of filing of the PRE:

7.7.3.1 A description of the issue;

7.7.3.2 The potential impact on the Work, Contract Price and/or Contract Time; and

7.7.3.3 An indication of the relief sought.

7.7.4 SUPPLEMENTATION. Additional detail of the content requirement under Section 7.7.3 shall be provided later if the detail is not yet available at the initial filing as follows:

7.7.4.1 While the issue is continuing or the impact is being determined, Contractor shall provide a written updated status report every thirty (30) days or as otherwise reasonably requested by DFCM; and

7.7.4.2 After the issue is concluded and/or the impact is determinable, complete information, including any impacts on Contract Price, Contract Time and/or other relief requested, if any, must be provided to DFCM within twenty-one (21) days of the earlier of the date the issue is concluded or the impact is determinable.

7.7.5 SUBCONTRACTORS. Contractor must include the provisions of this Section 7.7.5 in Contractor's subcontract with each Subcontractor and require each Subcontractor to do likewise in each Subcontractor's sub-subcontracts with Sub-subcontractors. At Contractor's discretion, Contractor may allow a Sub-subcontractor at the second tier and beyond to submit a PRE directly to Contractor.

7.7.5.1 In order for a Subcontractor at any tier to be involved with the PRE of DFCM, the following conditions and process shall apply:

7.7.5.1.1 The Subcontractor must have attempted to resolve the issue with Contractor, including the submission of a PRE with Contractor.

7.7.5.1.2 The Subcontractor must file a copy of the PRE with DFCM;

7.7.5.1.3 The PRE to Contractor must meet the time, content, and supplementation requirements of Sections 7.7.2, 7.7.3 and 7.7.4. The triggering event for a Subcontractor to file a PRE shall be the time at which the issue cannot be resolved through negotiation;

7.7.5.1.4 The PRE submitted to Contractor shall only be eligible for consideration in DFCM's PRE process to the extent the issue is reasonably related to the performance of DFCM or an entity for which DFCM is liable;

7.7.5.1.5 Contractor shall resolve the PRE with the Subcontractor within sixty (60) days of its submittal to Contractor or such other time period as subsequently agreed to by the Subcontractor in writing. If Contractor fails to resolve the PRE with the Subcontractor within such required time period, the Subcontractor may submit in writing the PRE with Contractor and DFCM. In order to be eligible for DFCM's consideration of the PRE, the Subcontractor must submit the PRE within twenty-one (21) days of the expiration of the time period for the Contractor/Subcontractor PRE process. DFCM shall consider the PRE as being submitted by Contractor on behalf of the Subcontractor;

7.7.5.1.6 Upon such PRE being submitted, Contractor shall cooperate with DFCM in reviewing the issue;

7.7.5.1.7 DFCM shall not be obligated to consider any submission which is not in accordance with any provision of this Section 7.7.5;

7.7.5.1.8 The Subcontractor may accompany Contractor in participating with DFCM regarding the PRE raised by the Subcontractor. DFCM shall not be precluded from meeting with Contractor separately, and it shall be the responsibility of Contractor to keep the Subcontractor informed of any such meetings; and

7.7.5.1.9 Notwithstanding any provision of this Section 7.7.5, a Subcontractor shall be entitled to pursue a payment bond claim.

7.7.6 INFORMATION AND MEETINGS. DFCM may request additional information and may meet with the parties involved with the issue.

7.7.7 CONTRACTOR REQUIRED TO CONTINUE PERFORMANCE. Pending the final resolution of the issue, unless otherwise agreed upon in writing by DFCM, Contractor shall proceed diligently with performance of the Work and DFCM shall continue to make payments of undisputed amounts in accordance with the Contract Documents.

7.7.8 DECISION. DFCM shall issue to Contractor, and any other third party brought into the process by DFCM as being potentially liable to DFCM, a written decision providing the basis for the decision on the issues presented by all of the parties within thirty (30) days of receipt of all the information required under Sections 7.7.3 and 7.7.4.

7.7.9 DECISION FINAL UNLESS CLAIM SUBMITTED. The decision by DFCM shall be final, and not subject to any further administrative or judicial review (not including judicial enforcement) unless a Claim is submitted in accordance with these General Conditions.

7.7.10 EXTENSION REQUIRES MUTUAL AGREEMENT. Any time period specified in Section 7.7 may be extended by mutual agreement of Contractor and DFCM.

7.7.11 IF DECISION NOT ISSUED. If the decision is not issued within the thirty (30) day period, stated in Section 7.7.8 including any agreed to extensions, the issue may be pursued as a Claim.

7.7.12 PAYMENT FOR PERFORMANCE.

7.7.12.1 Except as otherwise provided in the Contract Documents, any final decision where DFCM is to pay additional monies to Contractor, shall not be delayed by any PRE, Claim, or appeal by another party.

7.7.12.2 Payment to Contractor in accordance with any final decision shall be made by DFCM consistent with the Contract Documents.

7.7.12.3 Notwithstanding any other provision of the Contract Documents, payment to Contractor shall be subject to any set-off, claims, or counterclaims of DFCM.

7.7.12.4 Payment to Contractor for a Subcontractor issue submitted by the Contractor shall be paid by Contractor to Subcontractor in accordance with the subcontract between Contractor and Subcontractor.

7.7.12.5 Any payment or performance determined owing by Contractor to DFCM shall be made in accordance with the Contract Documents.

7.8. RESOLUTION OF CLAIM.

7.8.1 CLAIM. If the decision on the PRE is not issued within the required timeframe or if Contractor is not satisfied with the decision, Contractor, or other party brought into the process by DFCM, may submit a Claim in accordance with this Section 7.8 as a prerequisite for any further consideration by DFCM or the right to any judicial review of the issue giving rise to the Claim.

7.8.2 SUBCONTRACTORS. In order for a Subcontractor to have its issue considered in the Claim process by DFCM, the Subcontractor that had its issue considered under Section 7.7.5 may submit the issue as a Claim by filing it with Contractor and DFCM within the same timeframe and with the same content requirements as required of a Claim submitted by Contractor under this Section 7.8.2. DFCM shall consider the Claim as being submitted by Contractor on behalf of the Subcontractor. Under no circumstances shall any provision of these General Conditions or the Contract Documents be construed so as to create any contractual relationship between DFCM and any Subcontractor.

7.8.2.1 Upon such Claim being submitted, the Contractor shall fully cooperate with the Director, the person(s) evaluating the claim and any subsequent reviewing authority.

7.8.2.2 The Director shall not be obligated to consider any submission which is not in accordance with this Section 7.8.2.

7.8.2.3 The Subcontractor may accompany Contractor in participating with the Director, the person(s) evaluating the Claim and any subsequent reviewing authority regarding the Claim. The Director, the person(s) evaluating the Claim, and any subsequent reviewing authority is not precluded from meeting with Contractor separately, and it shall be the responsibility of Contractor to keep the Subcontractor informed of any such meetings and matters discussed.

7.8.2.4 Notwithstanding any provision of this Section 7.8, a Subcontractor shall be entitled to pursue a payment bond claim.

7.8.3 TIME FOR FILING. The Claim must be filed in writing promptly with the Director of DFCM, but in no case more than twenty-one (21) days after the decision is issued on the PRE under Section 7.7.8 or no more than twenty-one (21) days after the thirty (30) day period under Section 7.7.11 has expired with a decision not issued.

7.8.4 CONTENT REQUIREMENT. The written Claim shall include:

7.8.4.1 A description of the issues in dispute;

7.8.4.2 The basis for the Claim, including documentation and analysis required by the Contract Documents and applicable law and rules that allow for the proper determination of the Claim;

7.8.4.3 A detailed cost estimate for any amount sought, including copies of any related invoices; and

7.8.4.4 A specific identification of the relief sought.

7.8.5 EXTENSION OF TIME TO SUBMIT DOCUMENTATION. The time period for submitting documentation and any analysis to support a Claim may be extended by the Director upon written request of the claimant showing just cause for such extension, which request must be included in the initial Claim submittal.

7.8.6 CONTRACTOR REQUIRED TO CONTINUE PERFORMANCE. Pending the final determination of the Claim, including any judicial review or appeal process, and unless otherwise agreed upon in writing by the Director, Contractor shall proceed diligently with performance of the Contract and DFCM shall continue to make payments of undisputed amounts in accordance with the Contract Documents.

7.8.7 AGREEMENT OF CLAIMANT ON METHOD AND PERSON(S) EVALUATING THE CLAIM. The Director shall first attempt to reach agreement with the claimant on the method and person(s) to evaluate the Claim. If such agreement cannot be made within fourteen (14) days of filing of the Claim, the Director shall select the method and person(s), considering the purposes described in Rule R23-26-1. Unless agreed to by the Director and the claimant, any selected person shall not have a conflict of interest or appearance of impropriety. Any party and the person(s) evaluating the Claim has a duty to promptly raise any circumstances regarding a conflict of interest or appearance of impropriety. If such a reasonable objection is raised, and unless otherwise agreed to by the Director and the claimant, the Director shall take appropriate action to eliminate the conflict of interest or appearance of impropriety. The dispute resolution methods and person(s) may include any of the following:

7.8.7.1 A single expert and/or hearing officer qualified in the field that is the subject of the Claim;

7.8.7.2 An expert panel, consisting of members that are qualified in a field that is the subject of the Claim;

7.8.7.3 An arbitration process which may be binding if agreed to by the parties to the Claim;

7.8.7.4 A mediator; or

7.8.7.5 Any other method that best accomplishes the purposes set forth in Rule R23-26-1.

7.8.8 THE EVALUATION PROCESS, TIMEFRAMES OF EVALUATOR(S), DIRECTOR'S DETERMINATION, ADMINISTRATIVE APPEAL TO THE EXECUTIVE DIRECTOR AND JUDICIAL REVIEW. The Claim shall be evaluated, the timeframe for specific events related to the person(s) evaluating the Claim, the Director's determination, any appeal to the Executive Director and any judicial review shall be subject to the provisions of Rule R23-26-5(8), R23-26-5(9), R23-26-6 and R23-26-8. A copy of these Administrative Rules is available at <https://rules.utah.gov>.

7.8.9 APPEAL PROCESS PREREQUISITE FOR FURTHER CONSIDERATION OR JUDICIAL REVIEW. The administrative appeal to the Executive Director is a prerequisite for any further consideration by the State of Utah, or to judicial review of the issue giving rise to the Claim. It shall be

considered that the Contractor, or another party brought into the process by DFCM, has not exhausted its administrative remedies if such an administrative appeal is not undertaken.

7.8.10 PAYMENT OF CLAIM.

7.8.10.1 When a stand-alone component of a Claim has received a final determination, and is no longer subject to review or appeal, that amount shall be paid in accordance with the payment provisions of the Contract Documents or judicial order.

7.8.10.2 When the entire Claim has received a final determination, and is no longer subject to review or appeal, the full amount shall be paid within fourteen (14) days of the date of the final determination unless the Work or services have not been completed, in which case the amount shall be paid in accordance with the payment provisions of the Contract Documents to the point that the Work is completed.

7.8.10.3 The final determination date is the earlier of the date upon which the claimant accepted the settlement in writing with an executed customary release document and waived its rights of appeal, or the expiration of the appeal period, with no appeal filed, or the determination made resulting from the final appeal.

7.8.10.4 Any final determination where DFCM is to pay additional monies to Contractor shall not be delayed by any appeal or request for judicial review by another party brought into the process by DFCM as being liable to DFCM.

7.8.10.5 Notwithstanding any other provision of the Contract Documents, payment of all or part of a Claim shall be subject to any set-off, claims, or counterclaims of DFCM.

7.8.10.6 Payment to Contractor for a Subcontractor issue (Claim) deemed filed by Contractor, shall be paid by Contractor to the Subcontractor in accordance with the subcontract between Contractor and the Subcontractor.

7.8.10.7 The execution of a customary release document by the claimant related to any payment may be required as a condition of making the payment. Unless expressly and specifically released in writing by DFCM, settlement of a Claim by DFCM shall not be deemed a waiver of Claims reserved under Section 8.8.3.

7.8.11 ALLOCATION OF COSTS OF CLAIM RESOLUTION PROCESS.

7.8.11.1 In order to file a Claim, a claimant must pay a Fifteen Hundred Dollar (\$1,500.00.00) filing fee to DFCM. When the Claim is a pass-through from a Subcontractor in accordance with Section 7.7.5, the payment of the fee shall be made by the Subcontractor.

7.8.11.2 Unless otherwise agreed to by the parties to the Claim, the costs of resolving the Claim shall be allocated among the parties on the same proportionate basis as the determination of financial responsibility for the Claim.

7.8.11.3 The costs of resolving the Claim that are subject to allocation include the claimant's filing fee, the costs of any person(s) evaluating the Claim, the costs of making any required record of the process, and any additional testing or inspection procured to investigate and/or evaluate the Claim.

7.8.11.4 Each party shall be responsible for its own attorney fees.

7.8.12 ALTERNATIVE PROCEDURES. To the extent otherwise permitted by law, if all parties to a Claim agree in writing, a protocol for resolving a Claim may be used that differs from the process described in this Section 7.8.

7.8.13 IMPACT ON FUTURE SELECTIONS.

7.8.13.1 The presentation of a good faith and non-frivolous issue or Claim shall not be considered by DFCM in DFCM's selection process for a future award of contract; and

7.8.13.2 The submission of a bad faith and frivolous issue or Claim, or the failure by a Contractor to facilitate resolution of a Claim, may be considered in DFCM's evaluation of performance.

7.8.14* **DFCM'S RIGHT TO HAVE ISSUES, DISPUTES OR CLAIMS CONSIDERED.** As stated in Rule R23-26-1(6), Sections 7.7 and 7.8 do not limit the right of DFCM to have any of DFCM's issues, disputes or claims considered. DFCM reserves all rights to pursue DFCM's issues, disputes or claims in law or equity including, but not limited to, any or all of the following: damages, delay damages and impacts, losses, liability, patent or latent defects, or failure to perform under the Contract Documents. If the Director appoints an expert or a panel to consider any such issue(s), dispute(s) or claim(s) of DFCM, Contractor shall cooperate with such expert or panel process.

**The previous 'Section 7.8.14 REPORT TO THE BUILDING BOARD' has been removed as of 07122023.*

**The previous 'Section 7.8.15 DFCM'S RIGHT TO HAVE ISSUES, DISPUTES OR CLAIMS CONSIDERED' has been renumbered to Section 7.8.14 as of 07122023.*

ARTICLE 8. PAYMENTS AND COMPLETION.

8.1 SCHEDULE OF VALUES. With the first Application for Payment, Contractor shall submit to the A/E and DFCM a schedule of values allocated to all the various portions of the Work. The schedule of values shall be submitted on the form approved and provided by DFCM. The schedule of values must consist of a detailed and specific breakdown of values actually associated with the various items of Work and shall in no event be "frontloaded". The A/E shall make recommendations to DFCM regarding the schedule of values including any suggested modifications. When approved, including any approved modifications, by DFCM, it shall be the basis for future Contractor Applications for Payment. Contractor shall be entitled to reasonably reallocate values in the schedule of values with prior written notice to DFCM. Contractor shall not be entitled to payment until receipt and acceptance of the schedule of values.

8.2 APPLICATIONS FOR PAYMENT.

8.2.1 IN GENERAL. The following general requirements shall be met:

8.2.1.1 Contractor shall submit to the A/E an itemized Application for Payment for Work completed in accordance with the schedule of values and that reflects retainage as provided for in the Contractor's Agreement. The Application for Payment shall be on a form approved and provided by DFCM.

8.2.1.2 The Application for Payment shall be supported by such data substantiating Contractor's right to payment as DFCM or the A/E may require.

8.2.1.3 The Application for Payment may include requests for payment pursuant to approved Change Orders or Construction Change Directives.

8.2.1.4 The Application for Payment shall not include requests for payment for portions of the Work performed by a Subcontractor when Contractor does not intend to pay that Subcontractor because of a dispute or other reason.

8.2.1.5 In executing the Application for Payment, Contractor shall attest that Subcontractors involved with prior Applications for Payment have been paid, unless Contractor provides a detailed explanation why such

payment has not occurred. DFCM reserves the right to require Contractor to submit a Utah Conditional Waiver and Release Upon Progress Payment form from one or more Subcontractors.

8.2.2 PAYMENT FOR MATERIAL AND EQUIPMENT. Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the Work site for subsequent incorporation into the Work. If approved in advance by DFCM and A/E, payment may similarly be made for materials and equipment suitably stored off-site at a location agreed upon in writing. Payment for materials and equipment stored on or off-site shall be conditioned upon compliance by Contractor with procedures satisfactory to DFCM to establish DFCM's title to such materials and equipment or otherwise protect DFCM's interest, and shall include applicable insurance, storage, and transportation to the Work site for such materials and equipment stored off-site. DFCM may require copies of invoices or other suitable documentation.

8.2.3 WARRANTY OF TITLE. Contractor warrants that title to all Work covered by an Application for Payment shall pass to DFCM no later than the time for payment. Contractor further warrants that upon submittal of an Application for Payment, all Work for which Certificates for Payment have been previously issued and payments received from DFCM shall, to the best of Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances in favor of the Contractor, Subcontractors, or other persons or entities making a claim by reason of having provided labor, materials, and/or equipment relating to the Work.

8.2.4 HOLDBACK BY DFCM. Notwithstanding anything to the contrary contained in the Contract Documents, DFCM may, as a result of the claims resolution process, withhold any payment to Contractor if and for so long as Contractor fails to perform any of its obligations under the Contract Documents or otherwise is in default under any of the Contract Documents.

8.3 CERTIFICATES FOR PAYMENT.

8.3.1 ISSUED BY A/E. The A/E shall within seven (7) days after receipt of Contractor's Application for Payment, either issue to DFCM a Certificate for Payment, with a copy to the Contractor, for such amount as the A/E determines due or notify Contractor and DFCM in writing of the A/E's reasons for withholding certification in whole or in part as provided in Section 8.4.1. If the A/E fails to act within said seven (7) day period, Contractor may file the Application for Payment directly with DFCM and DFCM shall thereafter have twenty-one (21) days from the date of DFCM's receipt to resolve the amount to be paid and to pay the undisputed amount. The accuracy of Contractor's Applications for Payment shall be Contractor's responsibility, not A/E's.

8.3.2 A/E'S REPRESENTATIONS. The A/E's issuance of a Certificate for Payment shall constitute a representation to DFCM that to the best of the A/E's knowledge, information and belief, based upon the A/E's observations at the site, the data comprising the Application for Payment, and what is reasonably inferable from the observations and data, that the Work has progressed to the point indicated in the Application for Payment and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to minor deviations from the Contract Documents correctable prior to completion and to specific qualifications expressed by the A/E. The issuance of a Certificate for Payment shall further constitute a representation that Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment shall not be a representation that the A/E has: (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences or procedures; (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by DFCM to substantiate Contractor's right to payment; (4) ascertained how or for what purpose Contractor used money previously paid on account of Contract Price; or (5) any duty to make such inquiries.

8.4 DECISIONS TO WITHHOLD CERTIFICATION.

8.4.1 WHEN WITHHELD. The A/E may decide not to certify payment and may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect DFCM, if in the A/E's judgment the representations to DFCM required in Section 8.3.2 cannot be made. If the A/E is unable to certify payment in the amount of the Application for Payment, the A/E shall notify Contractor and DFCM as provided in Section 8.3.1. If Contractor and the A/E cannot agree on a revised amount, the A/E shall promptly issue a Certificate for Payment for the amount to which the A/E makes such representations to DFCM. The A/E may also decide not to certify payment or, because of subsequently discovered evidence or observations, may nullify the whole or part of a Certificate for Payment previously issued, to such extent as may be necessary in the A/E's opinion to protect DFCM from loss because of:

8.4.1.1 Defective Work not remedied;

8.4.1.2 Third party claims filed or reasonable evidence indicating probable filing of such claims;

8.4.1.3 Failure of Contractor to make payments properly to Subcontractors or for labor, materials, or equipment;

8.4.1.4 Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Price;

8.4.1.5 Damage to DFCM or another contractor;

8.4.1.6 Reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance of the Contract Price would not be adequate to cover actual or liquidated damages for the anticipated delay; or

8.4.1.7 Failure to carry out the Work in accordance with the Contract Documents.

8.4.2 CERTIFICATION ISSUED WHEN REASONS FOR WITHHOLDING REMOVED. When the reasons stated in Section 8.4.1 for withholding certification are removed, certification shall be made for such related amounts.

8.4.3 CONTINUE WORK EVEN IF CONTRACTOR DISPUTES A/E'S DETERMINATION. If Contractor disputes any determination by the A/E or the result of the claims resolution process with regard to any Certification of Payment, Contractor nevertheless shall expeditiously continue to prosecute the Work.

8.4.4 DFCM NOT IN BREACH. DFCM shall not be deemed to be in breach of Contractor's Agreement by reason of the withholding of any payment pursuant to any provision of the Contract Documents provided DFCM's action or such withholding is consistent with the results of the dispute resolution process.

8.5 PROGRESS PAYMENTS.

8.5.1 IN GENERAL, INTEREST OR LATE PAYMENTS.

8.5.1.1 Except as provided in Section 8.3.1, DFCM shall pay any undisputed amount within twenty-eight (28) days of the date that the Application for Payment was submitted to the A/E. In no event shall DFCM be required to pay any disputed amount.

8.5.1.2 Except as otherwise provided by law, if any payment is late based upon the provisions of the Contract Documents, Contractor shall be paid interest at the rate stated in Utah Code § 15-6-3.

8.5.2 CONTRACTOR AND SUBCONTRACTOR RESPONSIBILITY. Contractor shall promptly and no later than the date established in Utah Code § 15-6-5 pay each Subcontractor, upon receipt of payment from DFCM, out of the amount paid to Contractor on account of such Subcontractor's portion of the Work, the amount to which said Subcontractor is entitled. Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payment to its Sub-subcontractors in a similar manner.

8.5.3 INFORMATION FURNISHED BY A/E OR DFCM TO SUBCONTRACTOR. The A/E or DFCM shall, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by Contractor and action taken thereon by the A/E and DFCM on account of portions of the Work done by such Subcontractor.

8.5.4 DFCM AND A/E NOT LIABLE. Neither DFCM or A/E shall have an obligation to pay, monitor, or enforce the payment of money to a Subcontractor, except to the extent as may otherwise be required by law.

8.5.5 CERTIFICATE, PAYMENT OR USE NOT ACCEPTANCE OF DEFECTIVE WORK. A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Work by DFCM shall not constitute acceptance of Work that is not in accordance with the Contract Documents.

8.6 PAYMENT UPON SUBSTANTIAL COMPLETION. Upon Substantial Completion of the Work or designated portion thereof and upon application by Contractor and certification by the A/E, DFCM shall make payment, reflecting adjustment in retainage, if any, for such Work or portion thereof as provided in the Contract Documents. To the extent allowed by law, DFCM may retain until final completion up to twice the fair market value of the Work that has not been completed in accordance with the Contract Documents, or, in the absence of applicable Contract Documents, generally accepted craft standards.

8.7 PARTIAL OCCUPANCY OR USE.

8.7.1 IN GENERAL. DFCM may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with Contractor and authorized by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is Substantially Complete, provided DFCM and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of the warranties required by the Contract Documents. When Contractor considers a portion to be Substantially Complete, Contractor shall prepare and submit a list to the A/E as previously provided for herein. Consent of Contractor to partial occupancy or use shall not be unreasonably withheld. Contractor shall have continuing responsibility to protect the Work site and the Work during such partial occupancy or use and shall be responsible for damage except to the extent caused solely by DFCM during such partial occupancy or use. The stage of progress of the Work shall be determined by written agreement between DFCM and Contractor.

8.7.2 INSPECTION. Immediately prior to such partial occupancy or use, DFCM, Contractor and A/E shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

8.7.3 NOT CONSTITUTE ACCEPTANCE. Except to the extent it is agreed upon in writing by DFCM, partial occupancy or use of a portion of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

8.7.4 INSURANCE. Partial occupancy or use shall not commence until the insurance company or companies providing property insurance under Section 10.2 have provided any required consent to such partial

occupancy or use by endorsement or otherwise. DFCM shall take reasonable steps to obtain any required consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

8.8 FINAL PAYMENT.

8.8.1 CERTIFICATE FOR PAYMENT. The A/E's final Certificate for Payment shall constitute a further representation that the conditions listed in Section 8.8.2 as precedent to Contractor's being entitled to final payment have been fulfilled.

8.8.2 CONDITIONS FOR FINAL PAYMENT. Neither final payment nor any remaining retained percentage shall become due until Contractor submits to the A/E the following to the extent required by DFCM:

8.8.2.1 An affidavit that payrolls, bills for material and equipment, and other indebtedness connected with the Work (less amounts withheld by DFCM) have been paid or otherwise satisfied;

8.8.2.2 A current or additional certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and shall not be canceled or allowed to expire until at least twenty-eight (28) days prior written notice, by certified mail, return receipt requested, has been given to DFCM;

8.8.2.3 A written statement that Contractor knows of no reason that the insurance shall not be renewable to cover the period required by the Contract Documents;

8.8.2.4 If requested by the surety in a timely manner or by DFCM, consent of surety, to final payment;

8.8.2.5 Receipt of Record Drawings, Specifications, Addenda, Change Orders and other Modifications maintained at the site; the warranties, instructions, operation and maintenance manuals, and training videos required to be furnished by the Contract Documents;

8.8.2.6 Other data establishing payment or satisfaction of obligations, such as a Utah Waiver and Release Upon Final Payment form from Contractor, Subcontractors and Sub-subcontractors, receipts, other releases and waivers of liens, claims, security interests, or encumbrances arising out of Contractor's Agreement, to the extent and in such form as may be designated by DFCM. If a Subcontractor or Sub-subcontractor refuses to furnish a release or waiver required by DFCM, DFCM may require consent of surety to the final payment. If liens, claims, security interests, or encumbrances remain unsatisfied after payments are made, Contractor shall refund to DFCM all money that DFCM may be compelled to pay in discharging such liens, claims, security interests or encumbrances including all costs and reasonable attorney fees; and

8.8.2.7 A written statement demonstrating how Contractor shall distribute interest earned on retention to Subcontractors as required by Utah Code § 13-8-5.

8.8.3 WAIVER OF CLAIMS: FINAL PAYMENT. The making of final payment shall constitute a waiver of Claims by DFCM, except those arising from:

8.8.3.1 Liens, Claims, security interests, or encumbrances arising out of the Contract Documents and unsettled;

8.8.3.2 Failure of the Work to comply with the requirements of the Contract Documents;

8.8.3.3 Terms of warranties required by the Contract Documents; or

8.8.3.4 Claims arising within the one-year period for correction of the Work and Claims to the extent not barred by Utah Code § 78B-2-225 and/or Utah Code § 78B-4-513.

8.8.4 DELAYS NOT CONTRACTOR’S FAULT. If, after Substantial Completion of the Work, Final Completion is materially delayed through no fault of Contractor or by issuance of Change Orders affecting final completion, DFCM shall, upon application by Contractor and certification by the A/E, and without terminating Contractor’s Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. Such payment shall be made under terms and conditions governing final payment. Unless otherwise stated by DFCM in writing, the making of final payment shall constitute a waiver of claims by DFCM as provided in Section 8.8.3 for that portion of that Work fully completed and accepted by DFCM.

8.8.5 WAIVER BY ACCEPTING FINAL PAYMENT. Acceptance of final payment by Contractor or a Subcontractor shall constitute a waiver of Claims by that payee except those Claims previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 9. TESTS AND INSPECTIONS, SUBSTANTIAL AND FINAL COMPLETION, UNCOVERING, CORRECTION OF WORK AND GUARANTY PERIOD.

9.1 TESTS AND INSPECTIONS.

9.1.1 IN GENERAL. Tests, inspections, and approvals of portions of the Work required by the Contract Documents or by laws, rules, regulations, or orders of public authorities having jurisdiction shall be made at an appropriate time. Unless otherwise specifically set forth in the Contract Documents or agreed to by DFCM in writing, DFCM shall contract for such tests, inspections, and approvals with an independent entity, or with the appropriate public authority, and DFCM shall bear all related costs of tests, inspections, and approvals, except as provided below. If any of the Work is required to be inspected or approved by the terms of the Contract Documents or by any public authority, Contractor shall, at least two (2) working days prior to the time of the desired inspection, and following the procedures established by DFCM, request such inspection or approval to be performed. Contractor shall give the A/E timely notice of when and where tests and inspections are to be made so that the A/E may observe such procedures.

9.1.2 FAILURE OF AN INSPECTOR TO APPEAR. Work shall not proceed without any required inspection and the associated authorization by DFCM to proceed unless the following procedures and requirements have been met:

9.1.2.1 The inspection or approval was requested in a timely manner as provided in Section 9.1.1;

9.1.2.2 Contractor received written confirmation from the inspection entity that the inspection was scheduled;

9.1.2.3 Contractor has contacted or attempted to contact the inspector to confirm whether the inspector is able to perform the inspection as scheduled;

9.1.2.4 If the inspector informs Contractor that the inspector is unable to perform the inspection as scheduled or if Contractor is unable to contact the inspector, Contractor shall attempt to contact the A/E or DFCM for instruction; and

9.1.2.5 Contractor has documented the condition of the Work prior to being covered through photos or other means.

9.1.3 NONCONFORMING WORK. If procedures for testing, inspection, or approval under Section 9.1.1 reveal failure of portions of the Work to comply with the requirements established by the Contract

Documents, Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for DFCM's expenses, including the cost of retesting for verification of compliance if necessary, until DFCM accepts the Work in question as complying with the requirements of the Contract Documents.

9.1.4 CERTIFICATES. Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by Contractor and promptly delivered to the A/E.

9.1.5 A/E OBSERVING. If the A/E is to observe tests, inspections, or approvals required by the Contract Documents, the A/E shall do so with reasonable promptness and, where practicable, at the normal place of testing.

9.1.6 PROMPTNESS. Tests, inspections, and arrangements for approvals conducted pursuant to the Contract Documents shall be made promptly to avoid delay in the Work.

9.2 UNCOVERING OF WORK.

9.2.1 UNCOVER UNINSPECTED WORK. Except as provided in Section 9.2.3, if a portion of the Work is covered prior to an inspector's approval to proceed, it must be uncovered for the inspector's inspection and be replaced at Contractor's expense without change in the Contract Price and/or Contract Time.

9.2.2 OBSERVATION PRIOR TO COVERING. Except as provided in Section 9.2.3, if DFCM or the A/E has requested in writing to observe conditions prior to any Work being covered or if such observation is required by the Contract Documents, and the Work is covered without such observation, Contractor shall be required to uncover and appropriately replace the Work at Contractor's expense without change in the Contract Price and/or Contract Time. If Contractor requests an inspection and DFCM or the A/E, including any inspector of each, does not appear, Contractor shall immediately notify DFCM of such failure to appear, but shall not cover the Work without such inspection.

9.2.3 WHEN AN INSPECTOR FAILS TO APPEAR OR A/E OR DFCM DID NOT MAKE PRIOR REQUEST. If Work is performed by Contractor without an inspection as provided in Section 9.1.2 or if a portion of the Work has been covered which the A/E or DFCM has not specifically requested to observe prior to its being covered or such observation is not required by the Contract Documents, the A/E or DFCM may request to see such Work and it shall be uncovered by Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement, shall, by appropriate Change Order, be charged to DFCM. If such Work is not in accordance with the Contract Documents, Contractor shall pay such costs unless the condition was caused by DFCM or a separate contractor in which event DFCM shall be responsible for payment of such costs.

9.3 INSPECTIONS: SUBSTANTIAL AND FINAL.

9.3.1 SUBSTANTIAL COMPLETION INSPECTION. Prior to requesting a Substantial Completion inspection, Contractor shall prepare a comprehensive initial punchlist, including unresolved items from prior inspections, for review by DFCM and the A/E to determine if the Work is ready for a Substantial Completion inspection. If DFCM and A/E determine that the initial punchlist indicates that the Work is not Substantially Complete, the initial punchlist shall be returned to Contractor with written comments. If DFCM and A/E determines that the initial punchlist indicates that the Work may be Substantially Complete, the A/E shall promptly organize and perform a Substantial Completion inspection in the presence of DFCM and all appropriate authorities.

9.3.1.1 If the A/E reasonably determines that the initial punchlist prepared by Contractor substantially understates the amount of the Work remaining to be completed and the Work is not Substantially Complete, the A/E shall report this promptly to DFCM, and upon concurrence of DFCM, Contractor shall be assessed the costs of the inspection and punchlist review incurred by the A/E and DFCM.

9.3.1.2 When the Work or designated portion thereof is Substantially Complete, the A/E shall prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion; shall establish responsibilities of DFCM and Contractor for security, maintenance, heat, utilities, damage to the Work, and insurance; and shall fix the time within which Contractor shall finish all items on the punchlist accompanying the Certificate (“Punchlist Completion Date”). The Certificate of Substantial Completion shall require approval by DFCM. If there is a punchlist, Contractor shall proceed promptly to complete and correct items on the punchlist. Failure to include an item on the punchlist does not alter the responsibility of Contractor to complete all Work in accordance with the Contract Documents.

9.3.1.3 Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof except to the extent as provided otherwise in the Contract Documents or if such warranty is related to an item where the Work is not complete. Written warranties shall state the length of the warranty, which must comply with the Contract Documents.

9.3.1.4 The Certificate of Substantial Completion shall be submitted by the A/E to DFCM and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.

9.3.1.5 Except to the extent DFCM otherwise approves in advance and in writing, Contractor shall submit the following documents in order to achieve Substantial Completion: written warranties, guarantees, operation and maintenance manuals, and all complete as-built drawings. Contractor shall also provide or obtain any required approvals for occupancy. Contractor shall be responsible for the guaranty of all Work, whether performed by it or by its Subcontractors and Sub-subcontractors at any tier.

9.3.2 FINAL COMPLETION INSPECTION. Prior to requesting a final inspection, Contractor shall verify all punchlist items are corrected and completed. Once all punchlist items are corrected and completed, Contractor shall notify DFCM and request a final inspection. DFCM shall notify the A/E and perform a final inspection. When all punchlist items are completed, a final Application for Payment shall be provided by Contractor, certified by the A/E, and processed by DFCM.

9.3.3 PUNCHLIST COMPLETION. As compensation to DFCM for administrative costs incurred by DFCM as a result of delay in final project close-out, for each day subsequent to the Punchlist Completion Date that Contractor fails to complete the punchlist and subject to Section 8.8.4, Contractor shall pay to DFCM five percent (5%) of the liquidated damages amount stated in the Contractor’s Agreement.

9.4 CORRECTION OF WORK AND GUARANTY PERIOD.

9.4.1 CONTRACTOR CORRECT THE WORK. Contractor shall correct Work rejected by the A/E, an inspector or DFCM, or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. Contractor shall bear the costs of correcting such rejected Work, including additional testing and inspections and compensation for the A/E's and inspector's services and expenses made necessary thereby.

9.4.2 GUARANTY AND CORRECTION AFTER SUBSTANTIAL COMPLETION. If within one year after the date of Substantial Completion of the Work or designated portion thereof, or after the date for commencement of warranties established under Section 9.2.1 or by terms of an applicable special warranty or guaranty required by the Contract Documents, any of the Work is found not to be in accordance with the requirements of the Contract Documents, including failure to perform for its intended purpose, Contractor shall correct it promptly after receipt of written notice from DFCM to do so, unless DFCM has previously given Contractor a written acceptance of such condition. The period of one year shall be extended with respect to portions of the Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work. This obligation of Contractor under this Section 9.4.2 shall be operative notwithstanding the acceptance of the Work under the Contract Documents, the issuance of a final certificate of payment, partial or total occupancy and/or termination of Contractor's Agreement. DFCM shall give notice of observed defects with reasonable promptness; however, failure to give such notice shall not relieve Contractor of its obligation to correct the Work. All corrected Work shall be subject to a one-year guaranty period the same in all respects as the original Work, except that such guaranty period shall commence from the time of Substantial Completion of the corrected Work. This guaranty period does not affect DFCM's right to pursue any available remedies against Contractor, including, but not limited to, DFCM's right to pursue a cause of action for defective construction against Contractor within the time period established by Utah Code § 78B-2-225.

9.4.3 REMOVAL OF WORK.

9.4.3.1 Contractor shall promptly remove from the Work site all Work that DFCM and/or the A/E determines as being in nonconformance with the Contract Documents, whether incorporated or not.

9.4.3.2 Contractor shall promptly replace and re-execute any Work not in accordance with the Contract Documents without change in the Contract Price and/or Contract Time.

9.4.3.3 Contractor shall bear the expense of correcting destroyed or damaged construction, whether completed or partially completed, by DFCM or separate contractors destroyed or damaged by such removal or replacement.

9.4.3.4 If Contractor does not remove such rejected Work within a reasonable time, fixed by written notice, DFCM may have the Work removed and stored at the expense of Contractor.

9.4.3.5 If Contractor does not correct the nonconforming Work within a reasonable time, fixed by written notice, DFCM may correct it in accordance with Section 2.2.2 of these General Conditions.

9.4.4 NOT LIMIT OTHER OBLIGATIONS. Nothing contained in this Section 9.4 shall be construed to establish a period of limitation with respect to other obligations that Contractor may have under the Contract Documents. Establishment of the time period of one year as described in Section 9.4.2 relates only to the specific obligation of Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish Contractor's liability with respect to Contractor's obligations other than specifically to correct the Work.

9.5 ADDITIONAL WARRANTIES.

9.5.1 IN GENERAL. In addition to any other provisions of this Article 9, the following warranties shall apply:

9.5.1.1 Contractor warrants to DFCM that materials and equipment furnished under the Contract Documents shall be of good quality and new, except to the extent otherwise required or expressly permitted by the Contract Documents.

9.5.1.2 Contractor also warrants to DFCM that the Work shall be free from defects not inherent in the quality required or expressly permitted and that the Work shall conform with the requirements of the Contract Documents. Work not conforming to said requirements, including substitutions not implemented by Change Order, Construction Change Directive, or ASI as provided in Article 7, may be considered defective at DFCM's option.

9.5.2 EXCLUSION. Unless due to the negligent or intentional act or omission of Contractor or those under the Contractor's control, or as otherwise stated in the Contract Documents, Contractor's guaranty excludes remedy for damage or defect caused by abuse, modifications not executed by Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.

9.5.3 FURNISH EVIDENCE ON REQUEST. If requested by the A/E or DFCM, Contractor shall furnish satisfactory evidence as to the type and quality of materials and equipment.

9.6 ACCEPTANCE OF NONCONFORMING WORK. If DFCM prefers to accept Work that is not in accordance with the requirements of the Contract Documents, DFCM may do so in writing instead of requiring its removal and correction, in which case the Contract Price shall be reduced as appropriate. Such adjustment shall be effectuated whether or not final payment has been made.

ARTICLE 10. INSURANCE AND BONDS.

10.1 CONTRACTOR'S LIABILITY INSURANCE.

10.1.1 IN GENERAL. The Contractor shall purchase and maintain in a company or companies lawfully authorized to do business in the State of Utah such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by a Sub-subcontractor or anyone directly employed by them, or by anyone for whose acts they may be liable:

10.1.1.1 Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;

10.1.1.2 Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;

10.1.1.3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;

10.1.1.4 Claims for damages insured by usual personal injury liability coverage;

10.1.1.5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;

10.1.1.6 Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;

10.1.1.7 Claims for bodily injury or property damage arising out of completed operations;

10.1.1.8 Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 4.12; and

10.1.1.9 If the Contract Documents require the Contractor to provide and/or the Contractor provides professional services, claims for damages because of negligent errors or omissions in the performance of professional services.

10.1.2 COVERAGE. Without limiting Contractor's obligations or liabilities hereunder, the Contractor shall, at its sole expense, purchase and maintain the following insurance coverages required by Section 10.1.1 of these General Conditions from insurers authorized to do business in the state of Utah and rated "A-" or better with a financial size category of class VII or larger by the A.M. Best Company. The following insurance coverages required by Section 10.1.1 of these General Conditions shall be procured with the following terms and insurance limits unless otherwise agreed in writing by DFCM and the Contractor:

10.1.2.1 Commercial General Liability Insurance covering all liabilities for personal injury and property damage arising in connection with the Work, with limits of liability of Five Million Dollars (\$5,000,000.00) per each occurrence and in the aggregate.

10.1.2.2 Workers Compensation Insurance in compliance with all applicable laws of each jurisdiction in which the Work will be performed.

10.1.2.3 Employers Liability Insurance covering all liabilities for personal injuries of the Contractor's employees, with limits of liability of Five Million Dollars (\$5,000,000.00) for each occurrence and in the aggregate.

10.1.2.4 If the Contract Documents require the Contractor to provide and/or the Contractor provides professional services, Professional Liability Insurance with limits of liability of Two Million Dollars (\$2,000,000.00) for each claim and in the aggregate with a retroactive or effective date not later than the effective date of the Contractor's Agreement and with a deductible or self-insured retention of not greater than One Hundred Thousand Dollars (\$100,000.00) per claim.

10.1.2.5 Automobile Liability Insurance, including coverages of owned, non-owned and hired vehicles covering all liabilities for personal injury and property damage arising from the use of motor vehicles, with combined single limits of liability of Two Million Dollars (\$2,000,000.00) for each occurrence and in the aggregate.

10.1.2.6 If the Contractor is unable to obtain the insurance required by this Section 10.1, Contractor may carry excess liability insurance and/or umbrella insurance that, when combined with Contractor's primary coverage in a given category of insurance, brings the total coverage in such category to be not less than the amount required by this Section 10.1 for that category of insurance.

10.1.3 ENDORSEMENTS. The Contractor shall provide the following coverage endorsements for each category of insurance required by this Section 10.1, except in the case of Workers' Compensation Insurance, Employers' Liability Insurance and Professional Liability Insurance:

10.1.3.1 An endorsement including DFCM as an additional insured;

10.1.3.2 An endorsement including a cross liability clause, noting that each of the parties comprising the insured shall be considered as a separate entity, the insurance applies as if a separate policy has been issued to each party, and no “insured-versus-insured” exclusion exists in the policy.

10.1.3.3 An endorsement waiving all expressed or implied rights of subrogation against DFCM and the State of Utah.

10.1.4 TERMS. Except as otherwise expressly provided in Section 10.1.2, the insurance of the Contractor required to be maintained pursuant to this Section 10.1 shall be on the following terms:

10.1.4.1 All insurance shall begin no later than the effective date of the Contractor’s Agreement and shall continue until the final completion of the Work and for a period of two (2) years following the final completion of the Work, provided, however, if the Contractor’s Agreement is terminated prior to the final completion of the Work, such insurance shall continue for a period of two (2) years following the termination of the Contractor’s Agreement.

10.1.4.2 Before performing any of the Work and after each time the policies are renewed or varied, the Contractor shall provide to DFCM certificates of insurance and endorsements consistent with this Section 10.1.4 and Sections 10.1.1, 10.1.2 and 10.1.3 of these General Conditions. If required by DFCM the Contractor shall deliver copies of the insurance policies providing the insurance coverages required by this Section 10.1, and all endorsements thereto.

10.1.4.3 All insurance shall not be varied to the detriment of DFCM, cancelled or allowed to lapse until thirty (30) days’ prior written notice has been given to DFCM.

10.1.5 FAILURE TO PROVIDE. Should the Contractor at any time neglect or refuse to provide the insurance required by this Section 10.1, or should such insurance be canceled, DFCM shall have the right, but not the obligation, to procure the same at the cost and expense of the Contractor, and the cost thereof may be deducted by DFCM from any monies then due or thereafter to become due to the Contractor. If DFCM or the other Indemnified Parties are damaged by the failure of the Contractor to purchase or maintain insurance as required by this Section 10.1, the Contractor shall bear all reasonable costs, expenses and damages incurred by DFCM and/or the other Indemnified Parties arising from such failure to purchase or maintain the insurance required by this Section 10.1.

10.1.6 CERTIFICATES. The acceptance of delivery of any Certificates of Insurance or copies of insurance policies required to be purchased and maintained pursuant to the Contract Documents does not constitute approval or agreement by the recipient that the insurance requirements have been met or that those Certificates of Insurance or insurance policies comply with the Contract Documents.

10.1.7 NO LIMITATION. The Contractor shall procure such insurance coverages and such insurance limits for its insurance coverages that the Contractor, in its sole discretion, after consultation with its insurance and risk advisors, determines to be sufficient for Contractor’s purposes given the risks of the project. This Section 10.1 sets forth DFCM’s minimum insurance requirements; the Contractor may procure additional or broader insurance coverages or greater insurance limits than required by Section 10.1 at Contractor’s expense. Nothing in Section 10.1 or elsewhere in the Contract Documents is intended to limit the Contractor’s liability to DFCM or the Indemnified Parties to liabilities covered by the insurance coverages required by Section 10.1 or to the minimum insurance limits required of such insurance coverages by Section 10.1.

10.2 “BUILDER’S RISK” INSURANCE.

10.2.1 IN GENERAL. Provided that the Contractor’s Agreement is for new buildings, structures, or construction projects, or for the alteration or repair of, or addition to existing buildings, structures, or improvements (an “Eligible Project”), DFCM shall maintain insurance to protect the interest of the Contractor, Subcontractors, or Sub-subcontractors subject to all of the terms, conditions, limitations, exclusions, waivers and/or endorsements stated in the Commercial Property Policy Declarations and Scheduled Forms available on DFCM’s website, dfcm.utah.gov (“Builder’s Risk Insurance”).

10.2.2 DEDUCTIBLE. To the extent that the Builder’s Risk Insurance provides for a deductible (including, without limitation, a specific loss deductible, cumulative loss deductible and/or sub-deductible), with respect to any damages or losses to property covered by the Builder’s Risk Insurance caused in whole or in part by the negligence, breach of contractual duty or other fault of DFCM (or those for whom DFCM is responsible, including the A/E and the A/E’s consultants) or the Contractor (or those for whom the Contractor is responsible, including the Contractor’s Subcontractors and Sub-subcontractors of any tier), any deductible applicable to such covered damages or losses to property shall be paid by the party, whether DFCM or the Contractor, legally responsible for the negligence, breach of contractual duty or other fault that caused the losses or damages. If both DFCM and the Contractor are legally responsible in part for the negligence, breach of contractual duty or other fault that caused such losses or damages to property, DFCM and the Contractor shall pay any deductible applicable to such covered damages or losses to property in proportion to their comparative fault. With respect to any damages or losses to property covered by the Builder’s Risk Insurance caused by an act of nature, such as the weather or other natural disasters, and not caused in whole or in part by the negligence, breach of contractual duty or other fault of DFCM (or those for whom DFCM is responsible, including the A/E and the A/E’s consultants) or the Contractor (or those for whom the Contractor is responsible, including the Contractor’s Subcontractors and Sub-subcontractors of any tier), DFCM and Contractor shall each pay half of the amount of any deductible to such covered damages or losses to property.

10.2.3 WAIVER OF SUBROGATION. DFCM and Contractor waive all rights against: (1) each other and the other Indemnified Parties and any of their subcontractors, sub-subcontractors, agents and employees, each of the other; and (2) the A/E, A/E’s consultants, separate contractors described in Section 2.2, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent covered by Builder’s Risk Insurance obtained pursuant to Section 10.2.1 and maintained during the course of construction, but only to the extent of the actual recovery of insurance proceeds by the injured party, except such rights as they have to proceeds of such insurance held by DFCM as fiduciary. DFCM or Contractor, as appropriate, shall require of the A/E, A/E’s consultants, separate contractors described in Section 2.2, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged. The waiver of rights under this Section 10.2.3 shall not include: (1) subject to Section 10.2.2, the right to recover amounts deducted or excluded from the insurance proceeds in the form of deductibles paid by the injured party; and (2) claims arising out of design errors or omissions.

10.2.4 SPECIAL HAZARDS. If the Contractor’s Agreement is for an Eligible Project, but Contractor desires insurance coverage for risks other than those covered by the Builder’s Risk Insurance, the Contractor may obtain such insurance, however, the cost thereof shall be borne by the Contractor and shall not be included in the Contract Price.

10.2.5 NON-ELIGIBLE PROJECTS. If the Contractor’s Agreement is not for an Eligible Project, Contractor shall bear the risk of damage and/or loss to Contractor’s materials, equipment and other property,

until acceptance of the Work by DFCM in writing, and no protection from damage and/or loss of the Work (including, without limitation, so called “builders risk”, “course of construction”, “inland marine” and/or similar property insurance) will be provided by DFCM for the protection of Contractor. Contractor may obtain insurance to cover such risks, however, the cost thereof shall be borne by the Contractor and shall not be included in the Contract Price. Section 10.2.3 shall not apply to Non-Eligible Projects.

10.3 PERFORMANCE BOND AND PAYMENT BOND. The Contractor shall furnish a Performance and Payment Bond naming the Contractor as Principal and DFCM and DFCM’s designees as Obligees written on AIA Document A312 (2010) Performance Bond and Labor and Material Payment Bond forms in a penal sum of not less than the Contract Price for the Work as the Contract Price may be modified by Change Order (the “Bonds”). The cost of the Bonds, without mark-up, may be included in the Contract Price. The Contractor shall deliver the Bonds to DFCM at least three (3) days before the commencement of any Work at the Work site. Delivery of the Bonds may be accomplished *via* email. The Bonds shall be procured from a surety authorized to do business in the State of Utah and rated A- or better by the A.M. Best Company at the time of issuance of the Bonds and holding Certificates of Authority as an acceptable surety on federal bonds as listed by the United States Department of Treasury (Circular 570, as amended) in its most recent list at the time of issuance of the Bonds. The penal sum of the Bonds shall be within the maximum specified for such surety in Circular 570, as amended. The attorney-in-fact who executes the Bonds on behalf of the surety shall affix to the Bonds a certified and current copy of his or her power of attorney. If the surety on any of the Bonds furnished by the Contractor is declared a bankrupt or becomes insolvent or its rights to do business are terminated in the State of Utah or it ceases to meet the requirements of this Section 10.3, the Contractor shall within ten (10) calendar days thereafter substitute another bond and surety, both of which must be acceptable to DFCM. Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

ARTICLE 11. MISCELLANEOUS PROVISIONS.

11.1 A/E’S RESPONSIBILITIES. These General Conditions are not intended to provide an exhaustive or complete list of the A/E’s responsibilities. A separate agreement between DFCM and the A/E incorporates these General Conditions by reference and includes additional design and contract administration responsibilities.

11.2 SUCCESSORS AND ASSIGNS. DFCM and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to the other party hereto and to partners, successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in the Contract Documents. Contractor shall not assign Contractor’s Agreement without the prior written consent of DFCM, nor shall Contractor assign any amount due or to become due or any of Contractor’s rights under the Contract Documents, without prior written consent of DFCM.

11.3 WRITTEN NOTICE.

11.3.1 PERSONAL DELIVERY AND REGISTERED OR CERTIFIED MAIL. Written notice shall be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an officer of the corporation for which it was intended, or if delivered at or sent by registered or certified mail, return receipt requested, to the last business address known to the party giving notice.

11.3.2 E-MAIL. Notwithstanding any other provision of these General Conditions, written notice shall also be deemed to have been duly served by verified use of an e-mail system by using the known and operative e-mail address of the intended recipient. Service by use of the e-mail system is encouraged when timely notice shall benefit DFCM, the A/E, or Contractor. Notice shall be considered complete and verified upon the sending and confirmation of delivery using the e-mail system, if on the same day notice is also sent by registered or

certified mail, return receipt requested, to the last business address known to the party giving notice, confirming the e-mail delivery.

11.4 RIGHTS AND REMEDIES.

11.4.1 NOT LIMIT. 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.

11.4.2 NO WAIVER. Except as expressly provided elsewhere in the Contract Documents, no action or failure to act by DFCM, the A/E, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract Documents, nor shall such action or failure to act constitute approval or acquiescence in a breach thereunder, except as any of the above may be specifically agreed to in writing. In no case shall Contractor or any Subcontractors be entitled to rely upon any waiver of any of these General Conditions, unless agreed to in writing by DFCM.

11.5 NO DISCRIMINATION, NO SEXUAL HARASSMENT. Pursuant to the laws of the United States and the State of Utah, Contractor, Subcontractors, or anyone for whose act any of them may be liable, shall take affirmative action to not discriminate against any employee or applicant for employment because of race, creed, color, sex, religion, ancestry or national origin. To the extent applicable, said persons shall comply with all provisions of Executive Order No. 11246 dated September 24, 1965 and rules, regulations, orders, instructions, designations and other directives promulgated pursuant thereto. Contractor, Subcontractors, or anyone for whose act any of them may be liable, shall not act in any manner as would violate the laws, regulations, and policies of the United States or the State of Utah prohibiting sexual harassment.

11.6 APPLICABLE LAWS AND ENFORCEMENT. The Contract Documents shall be governed by and construed in accordance with the laws of the State of Utah, excluding any choice of law provisions that would otherwise require application of laws of any other jurisdiction.

11.7 INTERPRETATION. In the interest of brevity, the Contract Documents frequently omit modifying words such as “all” and “any” and articles such as “the” and “an”, but the fact that a modification or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

11.8 VENUE. In case of any dispute that may arise under the Contract Documents, the place of venue shall be in the County of Salt Lake, State of Utah, unless otherwise agreed to by all of the parties in writing.

11.9 SEVERABILITY. The invalidity of any provision or part of a provision of the Contract Documents shall not impair or affect in any manner the validity, enforceability, or effect of the remainder of the Contract Documents.

11.10 CONSTRUCTION OF WORDS. Unless otherwise stated in the Contract Documents, words which have well-known technical or construction industry meanings shall be construed as having such recognized meanings. Unless the context requires otherwise, all other technical words shall be construed in accordance with the meaning normally established by the particular, applicable profession or industry. All other words, unless the context requires otherwise, shall be construed with an ordinary, plain meaning.

11.11 NO THIRD-PARTY RIGHTS. These General Conditions create rights and duties only as between DFCM and Contractor, and DFCM and A/E. Nothing contained herein shall be deemed as creating third party beneficiary contract rights or other actionable rights or duties as between Contractor and A/E, or as between DFCM, Contractor, or A/E on the one hand, and any other person or entity.

ARTICLE 12. TERMINATION OR SUSPENSION OF THE CONTRACT.

12.1 TERMINATION BY CONTRACTOR FOR CAUSE.

12.1.1 IN GENERAL. If the Work is stopped for a period of sixty (60) days through no act or fault of the Contractor or a Subcontractor, or their agents or employees or any other persons performing portions of the Work under contract with any of the above, the Contractor may terminate the Contractor's Agreement in accordance with Section 12.1.2 for any of the following reasons:

12.1.1.1 Because DFCM has persistently failed to fulfill material obligations of DFCM under the Contract Documents with respect to matters important to the progress of the Work;

12.1.1.2 Issuance of an order of a court or other public authority having jurisdiction which necessitates such termination, except that where the Contractor has standing, the Contractor must cooperate in efforts to stay and/or appeal such order;

12.1.1.3 An act of government, such as a declaration of national emergency, making material unavailable; or

12.1.1.4 Unavoidable casualties or other similar causes.

12.1.2 NOTICE. If one of the reasons for termination in Section 12.1.1 exists, the Contractor may, upon fourteen (14) additional days' written notice to DFCM and A/E, and such condition giving cause for termination still not cured, terminate Contractor's Agreement and recover from DFCM payment for Work properly executed as of the date of termination, including profit and overhead on Work properly completed as of the date of termination, on a percentage completion basis, along with Contractor's reasonable demobilization expenses incurred within seven (7) days of termination, but Contractor shall in no event be entitled to recover consequential damages as a result of such termination or profit and/or overhead on the Work not executed.

12.2 TERMINATION BY DFCM FOR CAUSE.

12.2.1 IN GENERAL. DFCM may terminate the Contractor's Agreement if Contractor fails to cure any of the following within a period of seven (7) days (or longer if DFCM so approves in writing) after receipt of notice from DFCM specifying the breach or failure:

12.2.1.1 Contractor refuses or fails to supply enough properly skilled workers or proper materials;

12.2.1.2 Contractor fails to make payment to Subcontractors for materials, equipment, or labor;

12.2.1.3 Contractor disregards laws, ordinances, rules, regulations, or orders of a public authority having jurisdiction;

12.2.1.4 Contractor fails to perform the Work such that the Work will be Substantially Completed within the Contract Time or Contractor fails to make progress with the Work as required by the Contract Documents;

12.2.1.5 Contractor fails to perform the Work in accordance with the Contract Documents or is otherwise in breach of a material provision of the Contract Documents;

12.2.1.6 As permissible by law for a reason to terminate, Contractor is adjudged bankrupt;

12.2.1.7 As permissible by law for a reason to terminate, Contractor should make a general assignment for the benefit of creditors;

12.2.1.8 As permissible by law for a reason to terminate, Contractor should have a receiver appointed on account of Contractor's insolvency; or

12.2.1.9 Contractor fails to follow safety requirements and precautions either as expressly provided in the Contract Documents or as consistent with the customary practices in the industry.

12.2.2 DFCM'S RIGHT TO CARRY OUT THE WORK UPON TERMINATION FOR CAUSE. If Contractor fails to remedy the breach or failure within seven (7) days or other mutually agreed period after notice from DFCM, DFCM may, without prejudice to other remedies available to DFCM and in addition to enforcement of any other of DFCM's rights, terminate the Contractor's Agreement, take possession of the Work site and all materials, finish the Work by whatever reasonable method DFCM may deem expedient, and charge Contractor, or file a claim against Contractor's bankruptcy estate, for any additional costs incurred by DFCM to complete the Work. Contractor shall not be entitled to receive any further payment until the Work is completed, nor shall Contractor be relieved from its obligations and liabilities assumed under the Contractor's Agreement. If DFCM's costs exceed the amount of any payment(s) owed by DFCM to Contractor subject to offset by DFCM, DFCM may bill Contractor for the difference, which Contractor shall pay within twenty-eight (28) days of receipt of DFCM's invoice.

12.2.3 ITEMS REQUIRED TO BE TRANSFERRED OR DELIVERED. DFCM may require Contractor to transfer title and deliver to DFCM, in the manner and to the extent directed by DFCM:

12.2.3.1 Any completed portion of the Work; and

12.2.3.2 Any partially completed portion of the Work and any parts, tools, dies, jigs, fixtures, drawings, information, and contract rights as Contractor has specifically produced or specifically acquired for the performance of such part of the Work as has been terminated; and Contractor shall, upon direction of DFCM, protect and preserve property in the possession of Contractor in which DFCM has an interest.

12.2.4 PAYMENT. When DFCM terminates Contractor's Agreement for one or more of the reasons stated in Section 12.2.1, DFCM may withhold payment and/or pursue all available remedies.

12.2.5 DFCM PROTECTION IF LIENABLE. When the Work is lienable, DFCM may withhold from amounts otherwise due Contractor for such Work such amount as DFCM determines to be necessary to protect the State against loss because of liens.

12.2.6 CREDITS AND DEFICITS. If the unpaid balance of the Contract Price exceeds the full cost of finishing the Work, including compensation for the A/E's services and expenses made necessary thereby, such excess shall be paid to Contractor. If such cost exceeds the unpaid balance of the Contract Price, Contractor shall pay the difference to DFCM and this obligation for payment shall survive the termination of Contractor's Agreement.

12.2.7 IF CONTRACTOR FOUND NOT IN DEFAULT OR EXCUSABLE. If, after notice of termination of Contractor's Agreement under the provisions of Section 12.2, it is determined for any reason that Contractor was not in default under the provisions of Section 12.2, or that the default was excusable under the provisions of Section 12.2, the rights and obligations of the parties shall be the same as if the notice of termination had been issued pursuant to the termination for convenience provisions of Section 12.3.

12.2.8 RIGHTS AND REMEDIES NOT EXCLUSIVE. The rights and remedies of DFCM provided in this Section 12.2 shall not be exclusive and are in addition to any other rights and remedies provided by law or under the Contract Documents.

12.2.9 TIME PERIOD FOR CLAIMS. Any PRE by Contractor for adjustment under this Section 12.2 must be asserted by Contractor, in writing, within twenty-one (21) days from the date of termination; provided that DFCM may, in its sole discretion, receive and act upon any such PRE asserted at any time prior to final payment under Contractor's Agreement.

12.3 TERMINATION FOR CONVENIENCE OF DFCM.

12.3.1 IN GENERAL. The performance of Work under Contractor's Agreement may be terminated by DFCM in accordance with this Section 12.3 in whole or in part, or from time to time, whenever DFCM shall determine that such termination is in the best interest of DFCM or any person or entity for whom DFCM is acting under Contractor's Agreement. Any such termination shall be effectuated by delivery to Contractor of a notice of termination specifying the extent to which performance of Work is terminated and the date upon which such termination becomes effective.

12.3.2 CONTRACTOR OBLIGATIONS. After receipt of a notice of termination, and except as otherwise directed by DFCM in writing, the Contractor shall:

12.3.2.1 Stop Work under Contractor's Agreement on the date and to the extent specified in the notice of termination;

12.3.2.2 Place no further orders or subcontracts for materials, services or facilities, except as may be necessary for completion of such portion of the Work that is not terminated;

12.3.2.3 Terminate all orders and subcontracts to the extent that they relate to performance of Work terminated by the notice of termination;

12.3.2.4 Assign to DFCM in the manner, at the times, and to the extent directed by DFCM, all of the right, title, and interest of Contractor under the orders and subcontracts so terminated, in which case DFCM shall have the right, in its discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts;

12.3.2.5 Settle all outstanding liabilities and all claims arising out of such termination of orders and subcontracts, with the approval or ratification of DFCM, which approval or ratification shall be final for all the purposes of this Section 12.3;

12.3.2.6 Transfer title and deliver to DFCM in the manner, at the times, and to the extent, if any, directed by DFCM:

12.3.2.6.1 The fabricated or unfabricated parts, Work in process, completed Work, supplies, and other material produced as a part of, or acquired in connection with the performance of the Work terminated by the notice of termination; and

12.3.2.6.2 The completed or partially completed drawings, information, and other property which, if Contractor's Agreement had been completed, would have been required to be furnished to DFCM;

12.3.2.7 Use best efforts to sell, in the manner, at the times, to the extent, and at the price or prices directed or authorized by DFCM, any property of the types referred to in Section 12.3.2.6; provided, however, that Contractor:

12.3.2.7.1 Shall not be required to extend credit to any purchaser; and

12.3.2.7.2 Shall dispose of any such property under the conditions prescribed by and at a price or prices approved by DFCM; and provided further that the proceeds of any such transfer of or disposition shall be applied in reduction of any payments to be made by DFCM to Contractor under Contractor's Agreement or shall otherwise be credited against the Contract Price or paid in such other manner as DFCM may direct;

12.3.2.8 Complete performance of such part of the Work as shall not have been terminated by the notice of termination; and

12.3.2.9 Take such action as may be necessary, or as DFCM may direct, for the protection and preservation of the property related to Contractor's Agreement which is in the possession of Contractor in which the State of Utah has or may acquire an interest.

12.3.3 TERMINATION CLAIM. After receipt of a notice of termination, Contractor may submit to DFCM a PRE, in the form and with certification prescribed by DFCM. Such PRE shall be submitted promptly but in no event not later than twenty-one (21) days from the effective date of termination.

12.3.4 AGREED UPON PAYMENT. Subject to the provisions of Section 12.3.3 above, Contractor and DFCM may agree upon the amount to be paid to Contractor by reason of the total or partial termination of Work pursuant to this Section 12.3.

12.3.5 PAYMENT NOT AGREED UPON. In the event Contractor and DFCM fail to agree as provided in Section 12.3.4 upon the whole amount to be paid to Contractor by reason of the termination of Work pursuant to this Section 12.3, DFCM shall pay to the Contractor the amounts determined by DFCM as follows, but without duplication of any amounts agreed upon in accordance with Section 12.3.4:

12.3.5.1 With respect to all Work performed prior to effective date of termination, the total (without duplication of any items) of:

12.3.5.1.1 The cost of such Work including undisputed Claim amounts;

12.3.5.1.2 The cost of terminating, settling and paying claims arising out of the termination of Work under subcontracts or orders as provided in Section 12.3.2.5, exclusive of the amounts paid or payable on account of supplies or materials delivered or services furnished by Subcontractors prior to the effective date of termination under Contractor's Agreement, which amounts shall be included in the cost on account of which payment is made under Section 12.3.5.1.1;

12.3.5.1.3 An amount, as overhead and profit on Section 12.3.5.1.1 above, determined by DFCM to be fair and reasonable;

12.3.5.1.4 The reasonable cost of the preservation and protection of property incurred pursuant to Section 12.3.2.9; and any other reasonable cost incidental to termination of Work, including expenses incidental to the determination of the amount due to Contractor as the result of the termination of Work.

12.3.5.1.5 The total amount to be paid to Contractor under Section 12.3.5.1 above shall not exceed the Contract Price as reduced by the amount of payments otherwise made and as further reduced by the Contract Price of Work not terminated. Except for normal spoilage, and except to the extent that DFCM shall have otherwise expressly assumed the risk of loss in writing, there shall be excluded from the amounts payable to Contractor under Section 12.3.5.1 above, the fair value of property which is destroyed, lost, stolen, or damaged so as to become undeliverable to DFCM, or to a buyer pursuant to Section 12.3.2.7.

12.3.6 DEDUCTIONS. In arriving at the amount due Contractor under this Section 12.3, there shall be deducted:

12.3.6.1 All unliquidated advance or other payments on account theretofore made to the Contractor, applicable to the terminated portion of Contractor's Agreement;

12.3.6.2 Any Claim which DFCM and/or the State of Utah may have against Contractor in connection with Contractor's Agreement; and

12.3.6.3 The agreed price for, or the proceeds of sale of, any materials, supplies, or other things acquired by Contractor or sold, pursuant to the provisions of this Section 12.3, and not otherwise recovered by or credited to DFCM.

12.3.7 PARTIAL TERMINATION. If the termination is partial, Contractor may file with DFCM a PRE for the amounts specified in Contractor's Agreement relating to the continued portion of Contractor's Agreement and such equitable adjustment as may be agreed upon shall be made in such amounts. Any PRE under this Section 12.3.7 must be filed within twenty-one (21) days from the effective date of the partial termination.

12.3.8 PARTIAL PAYMENTS. DFCM may, from time to time, under such terms and conditions as it may prescribe, make partial payments and payments on account against costs incurred by Contractor in connection with the terminated portion of Contractor's Agreement whenever, in the opinion of DFCM, the aggregate of such payments shall be within the amount to which Contractor shall be entitled hereunder. If the total of such payments is in excess of the amount finally agreed or determined to be due under this Section 12.3, such excess shall be payable by Contractor to DFCM upon demand, together with interest at a rate stated in Utah Code § 15-1-1, for the period until the date such excess is repaid to DFCM; provided, however, that no interest shall be charged with respect to any such excess payment attributable to a reduction in Contractor's claim by reason of retention or other disposition of termination inventory until fourteen (14) days after the date of such retention or disposition, or such later date as determined by DFCM by reason of the circumstances.

12.3.9 PRESERVE AND MAKE AVAILABLE RECORDS. Unless otherwise provided for in Contractor's Agreement, or by applicable law, Contractor shall, from the effective date of termination until the expiration of three years after final settlement under Contractor's Agreement, preserve and make available to DFCM at all reasonable times at the office of Contractor, but without charge to DFCM, all books, records, documents, and other evidence bearing on the costs and expenses of Contractor under Contractor's Agreement and relating to the Work terminated hereunder, or, to the extent approved by DFCM, photographs, or other authentic reproductions thereof.

12.3.10 SUSPENSION, DELAY OR INTERRUPTION OF WORK BY DFCM FOR CONVENIENCE. DFCM may in writing and without cause, order Contractor to suspend, delay, or interrupt the Work, in whole or in part, for such period of time as DFCM may determine to be appropriate for the convenience of DFCM.

12.4 DFCM'S RIGHT TO STOP THE WORK. If Contractor fails to correct Work or fails to carry out Work as required by the Contract Documents or fails to comply with all required and customary safety precautions; DFCM, in writing, may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of DFCM to stop the Work shall not give rise to a duty on the part of DFCM to exercise this right for the benefit of Contractor or any other person or entity.



Division of Facilities Construction and Management

GENERAL CONDITIONS

August 31, 2020

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GENERAL CONDITIONS

August 31, 2020

THESE GENERAL CONDITIONS (“General Conditions”) are part of and subject to the Contractor’s Agreement (defined below) between DFCM (defined below) and Contractor (defined below).

ARTICLE 1. GENERAL PROVISIONS.

1.1 DEFINITIONS.

ARCHITECT/ENGINEER OR A/E. “Architect / Engineer” or “A/E” means the person or entity practicing as a design professional, including architect, engineer, interior designer, and/or landscape architect, retained under separate agreement with DFCM to act on behalf of DFCM according to the Contract Documents (defined below) and the A/E’s employees, representatives and consultants. For Work (defined below) where there is no A/E hired by DFCM, references in these General Conditions to A/E shall be deemed to refer to DFCM’s Representative.

ADDENDA. “Addenda” means the written or graphic instruments issued prior to the execution of the Contractor’s Agreement (defined below) that clarify, correct, or change the bidding documents or the Contract Documents.

A/E’s SUPPLEMENTAL INSTRUCTION OR ASI. “A/E’s Supplemental Instruction” or “ASI” means a supplemental instruction issued by the A/E to Contractor that results in a clarification, correction, or minor change in the Work and does not affect the Contract Time (defined below) or the Contract Price (defined below).

AMENDMENT. “Amendment” means any document or communication that changes (or purports to change) the terms of Contractor’s Agreement and/or the General Conditions, except as to: (1) scope of the Work; (2) Contract Price; and/or (3) Contract Time. With the exception of Supplemental General Conditions (defined below), no Amendment shall be valid and/or binding on DFCM unless: (1) the Amendment is set forth in a separate document, clearly titled “Amendment”; and (2) the Amendment is specifically and expressly accepted in writing by the Director (defined below).

BID. “Bid” means the offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

BONDS. “Bonds” means collectively the bid bond, performance bond, payment bond, and any other instruments of security.

CHANGE ORDER. “Change Order” means a written instrument signed by both DFCM and Contractor, issued after the execution of the Contractor’s Agreement on DFCM’s form, authorizing: (1) a change in the Work; (2) an adjustment of the Contract Price; and/or (3) an adjustment of the Contract Time.

CLAIM. “Claim” means a dispute, demand, assertion or other matter submitted by Contractor, including a subcontractor at any tier, subject to the provisions of these General Conditions. The claimant may seek, as a matter of right, modification, adjustment or interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. A request for Preliminary Resolution Effort (“PRE”) (defined below) shall not be considered a “Claim”. A request for an amendment of the Contract Documents, requested Change Order or a Construction Change Directive (“CCD”) (defined below) is not a PRE or Claim unless agreement cannot be reached, and the procedures of these General Conditions are followed.

CONSTRUCTION CHANGE DIRECTIVE. “Construction Change Directive” means a written order signed by DFCM, issued after execution of the Contractor’s Agreement, directing Contractor to perform a change in the Work and stating a proposed basis for adjustment, if any, in the Contract Price and/or Contract Time.

CONTRACT DOCUMENTS. “Contract Documents” means collectively Contractor’s Agreement, these General Conditions of Contractor’s Agreement, applicable Supplemental General Conditions, Drawings (defined below), Specifications (defined below), Addenda, other documents listed in the Contractor’s Agreement, authorized Amendments and Supplementary Conditions and Modifications (defined below) issued after execution of the Contractor’s Agreement. The Contract Documents shall also include the bidding/proposal documents, including the Instructions to Bidders/Proposers, Notice to Contractors and the Bid/Proposal Form, to the extent not in conflict with the other above-stated Contract Documents and other documents and oral representations which are memorialized in writing and documented as an attachment to the Contractor’s Agreement.

CONTRACT PRICE. “Contract Price” means the total amount payable by DFCM to Contractor for performance of the Work, including any authorized changes in the Work.

CONTRACT TIME. “Contract Time” means the time within which Contractor shall complete the Work, including any authorized changes in the Work

CONTRACTOR. “Contractor” means the person or entity identified as such in the Contractor’s Agreement. As used in the Contract Documents, “Contractor” includes Contractor’s employees, agents, representatives, subcontractors at any tier, and any other third party hired by Contractor to perform a portion of the Work and is referred to throughout the Contract Documents as if singular in number.

CONTRACTOR’S AGREEMENT. “Contractor’s Agreement” means, unless the context requires otherwise, the agreement executed by the Contractor and DFCM for the Work.

DAY. “Day” or “days” means calendar day unless otherwise specifically defined.

DEFECTIVE. “Defective” is an adjective which when modifying the word “Work” refers to Work that does not conform to the Contract Documents, or does not meet the requirements of any inspection, referenced standard, code, test or approval referred to in the Contract Documents, or which fails to meet generally accepted craft standards, or which has been damaged.

DIRECTOR. “Director” means the Director of the Division of Facilities Construction and Management, unless the context requires otherwise. Director may include a designee selected by the Director for a particular function described in the Contract Documents.

DFCM. “DFCM” means the State of Utah, Division of Facilities Construction and Management. Unless the context requires otherwise, DFCM is the “Owner” as that term is commonly understood in the construction industry.

DRAWINGS. “Drawings” means the graphic and pictorial portions of the Contract Documents, wherever located and whenever issued, showing the design, location, and dimensions of the Work and generally includes drawings, elevations, sections, details, schedules, and diagrams, including electronic copies.

EXECUTIVE DIRECTOR. “Executive Director” means the Executive Director of the Utah Department of Administrative Services, including unless otherwise stated, the Executive Director’s duly authorized designee.

FINAL COMPLETION. “Final Completion” means the date when all Work to be performed by Contractor has been completed and accepted in writing by DFCM.

INSPECTION. “Inspection” or its derivatives means a review of the Work, including but not limited to a visual review of the Work completed to date to ascertain if the Work is in accordance with the Contract Documents, including all applicable building codes and construction standards.

MODIFICATION. “Modification” means: (1) a Change Order; (2) a Construction Change Directive; or (3) an ASI. Contractor’s Agreement may be amended or modified only by: (1) an authorized Amendment; or (2) a Modification.

NOTICE TO PROCEED. “Notice to Proceed” means a document prepared by DFCM that authorizes Contractor to commence Work. It shall be deemed issued upon being sent by DFCM to Contractor’s address specified in Contractor’s Bid.

PRELIMINARY RESOLUTION EFFORT OR PRE. “Preliminary Resolution Effort” or “PRE” means the processing of a request for preliminary resolution or any similar notice about an issue that could potentially lead to a Claim and is prior to reaching the status of a Claim.

PRODUCT DATA. “Product Data” means illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by Contractor to illustrate materials or equipment for some portion of the Work.

PROPOSAL REQUEST OR PR. “Proposal Request” or “PR” means a request made by DFCM to Contractor requesting a proposal to resolve an issue as part of the Change Order process.

PROPOSED CHANGE ORDER OR PCO. “Proposed Change Order” or “PCO” means a request by Contractor submitted to the DFCM Representative to commence the Change Order process. It shall not be considered a “PRE” or a “Claim”. The PCO may be related to any potential or actual delay, disruption, unforeseen condition or any other matter for which Contractor intends to seek an increase in the Contract Price and/or extension of the Contract Time.

REQUEST FOR INFORMATION OR RFI. “Request for Information” or “RFI” means a written request from Contractor to the A/E seeking information, direction, or clarification related to the Contract Documents, including Drawings and/or Specifications.

RULE. “Rule”, unless the context requires otherwise, means a rule of the Utah Administrative Code.

SALES TAX AND/OR USE TAX. “Sales Tax” and/or “Use Tax”, unless the context requires otherwise, means the sales tax and/or use tax collected or to be collected by the Utah State Tax Commission and shall

include any sales and/or use tax that the Utah State Tax Commission collects on behalf of any special district, local government, or political subdivision.

SAMPLES. “Samples” mean physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work shall be judged.

SHOP DRAWINGS. “Shop Drawings” means drawings, diagrams, schedules and other data specially prepared for the Work by Contractor, or a subcontractor at any tier, manufacturer, supplier or distributor to illustrate some portion of the Work.

SPECIFICATIONS. “Specifications” means that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction systems, standards, installation and workmanship for the Work and performance of related systems and services.

SUBCONTRACTOR. “Subcontractor” means any person or entity under contract with Contractor to provide services or labor for the Work. “Subcontractor” includes a trade contractor or specialty contractor. “Subcontractor” does not include suppliers who provide only materials, equipment or supplies to Contractor or a Subcontractor. The term “Subcontractor” is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or authorized representative of the Subcontractor. The term “Sub-subcontractor” means a person or entity that has a contract with a Subcontractor to provide services or labor for the Work and also includes all lower tier sub-subcontractors. The terms “Subcontractor” and “Sub-subcontractor” do not include a separate contractor retained by DFCM or subcontractors or sub-subcontractors of a separate contractor retained by DFCM.

SUBSTANTIAL COMPLETION. “Substantial Completion” and its derivatives means the date certified in accordance with *Section 9.3** when the Work, or a designated portion thereof, is sufficiently complete, and any lack of completion or performance does not materially interfere with DFCM’s intended use of the Work, in accordance with the Contract Documents, so that DFCM can occupy and use the Work for its intended use. DFCM’s “intended use” or “occupy” as used in this definition, shall include any intended use or occupation by any agency or entity that DFCM intends to use or occupy the Work.

**Revised numbering from ‘Section 9.2’ to ‘Section 9.3’ as of 07122023.*

SUPPLEMENTAL GENERAL CONDITIONS. “Supplemental General Conditions” means the Supplemental General Conditions identified on DFCM’s website, dfcm.utah.gov, applicable to the Work, if any, that supplements these General Conditions. Supplemental General Conditions are authorized Amendments.

SUPPLEMENTARY CONDITIONS. “Supplementary Conditions” means the part of the Contract Documents, if any, that amends or supplements these General Conditions and/or applicable Supplemental General Conditions. Supplementary Conditions, if authorized, are an Amendment.

WORK. “Work” means the construction, services, supervision, labor, tools, equipment, materials, products and transportation, to be furnished by Contractor, so as to fulfill the Contractor’s obligations as required by the Contract Documents.

ARTICLE 2. DFCM.

2.1 INFORMATION AND SERVICES REQUIRED OF DFCM.

2.1.1 DFCM’S REPRESENTATIVE. DFCM shall designate a representative authorized to act on behalf of DFCM with respect to the Work (“DFCM’s Representative”). Unless the context requires otherwise, “DFCM’s Representative” is the “Owner’s representative” as that term is commonly understood in the construction industry. DFCM’s Representative shall have authority to review and approve the Work, including

the time schedule for completion, and the authority (but not a duty) to stop the Work for any reason, including, without limitation, unsafe conditions, or to direct Contractor to remedy, repair, or replace any Work, if necessary, to ensure its proper execution. DFCM and DFCM's Representative shall endeavor to render decisions pertaining to documents submitted by the A/E and/or Contractor to avoid a delay in the orderly and sequential progress of the Work. Contractor shall be responsible for time lost and the cost of correcting Work that in DFCM's judgment was executed improperly. DFCM shall be the final interpreter of the Contract Documents; the decision of DFCM in the absence of arbitrary or capricious conduct shall be conclusive. Notwithstanding anything to the contrary in the Contract Documents, DFCM's approval shall not relieve Contractor of Contractor's sole responsibility for the Work.

2.1.2 SPECIALISTS AND INSPECTORS. DFCM shall provide building inspection services in accordance with the applicable building codes, including routine and special inspections unless otherwise noted in the Contract Documents. DFCM may assign an inspector or specialist to note deviations from, or necessary adjustments to, the Contract Documents or to report deficiencies or defects in the Work. The inspector's or specialist's activities in no way relieve Contractor from the responsibilities set forth in the Contract Documents.

2.1.3 SURVEYS AND LEGAL DESCRIPTION. Except to the extent not applicable to the type of Work to be performed pursuant to Contractor's Agreement, DFCM shall furnish surveys describing physical characteristics, legal limitations and utility locations for the Work site, and a legal description of the Work site. The Contractor shall be entitled to rely on the accuracy of such survey information furnished by DFCM but shall exercise proper precautions relating to the safe performance of the Work. The Contractor recognizes that the exact location of underground or hidden utilities, plumbing and electrical runs may be somewhat different from the location indicated on such surveys furnished by DFCM or in the Contract Documents. The Contractor shall exercise reasonable skill and care to locate underground or hidden utilities, plumbing and electrical runs that are to remain to prevent damage thereto. The Contractor shall review the survey information provided by DFCM and shall promptly provide written notice to DFCM of any survey information that Contractor knows or discovers to be inaccurate.

2.1.4 PROMPT INFORMATION AND SERVICES. Upon receipt of a written request from Contractor, DFCM shall endeavor to furnish information or services under DFCM's control with reasonable promptness to avoid delay in the orderly progress of the Work.

2.1.5 COPIES OF CONTRACT DOCUMENTS. Unless otherwise provided in the Contract Documents, DFCM shall provide or make available to Contractor, free of charge, paper or electronic copies of Contract Documents, as determined by DFCM, as are reasonably necessary for execution of the Work. DFCM's website may also provide Contract Documents for the Work.

2.2 CONSTRUCTION BY DFCM OR BY SEPARATE CONTRACTORS.

2.2.1 DFCM'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS. DFCM reserves the right to enter into contracts with third parties in connection with the Work and to perform construction or other activities itself on or about the Work site.

2.2.2 COORDINATION OF WORK. Contractor shall afford DFCM and the separate contractors or subcontractors retained by DFCM adequate opportunity for the introduction and storage of their materials and equipment and the execution of their work. Contractor shall properly connect and coordinate the Work with the work of DFCM and separate contractors or subcontractors.

2.2.3 COORDINATION OF SCHEDULES. Contractor shall cooperate with DFCM and any separate contractors and subcontractors hired by DFCM in performing the Work so that all portions of the Work may be completed in the shortest possible time within normal working hours. Contractor shall furnish separate contractors and subcontractors full information regarding time schedules for Contractor's Work. Contractor

shall coordinate the Work with the workers who may be retained by DFCM, all separate contractors and subcontractors, and their activities in the vicinity of the Work site.

2.2.4 REPORTING PROBLEMS TO DFCM. If part of Contractor's Work depends on work by DFCM or a separate contractor, Contractor shall, prior to proceeding with that portion of the Work, promptly report in writing to DFCM any apparent defects in workmanship of the work of DFCM and/or such separate contractor that would render it unsuitable for proper execution of the Work. Failure of Contractor to report defects shall constitute an acknowledgment that DFCM's or the separate contractor's completed or partially completed work is fit and proper to receive Contractor's Work, except as to defects in workmanship not then reasonably discoverable.

2.2.5 CONTRACTOR REMEDIAL WORK. If Contractor causes damage to the work of DFCM or any separate contractors or subcontractors, Contractor shall promptly remedy such damage and shall use all reasonable efforts to promptly negotiate a settlement with DFCM and such separate contractors and subcontractors.

ARTICLE 3. A/E.

3.1 A/E'S ADMINISTRATION OF THE CONTRACT.

3.1.1 IN GENERAL. The A/E shall assist DFCM in administering the Contract in accordance with the Contract Documents. The A/E shall have authority to act on behalf of DFCM, but only to the extent provided in the Contract Documents and/or A/E's agreement with DFCM.

3.1.2 SITE VISITS.

3.1.2.1 Site visits or inspections by the A/E or DFCM shall in no way limit or affect Contractor's responsibility to comply with all the requirements and the overall design concept of the Contract Documents as well as all federal, state, and local laws, rules, regulations, ordinances and orders of public authorities applicable to the Work.

3.1.2.2 The A/E shall promptly submit to DFCM a written report subsequent to each site visit detailing the visit.

3.1.3 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION. Except as authorized by DFCM or as otherwise provided in the Contract Documents, including these General Conditions, the A/E and Contractor shall communicate through DFCM on issues regarding the timing of the Work, cost of the Work, and scope of the Work. Communications by and with the A/E's consultants shall be through the A/E. Communications by and with Subcontractors shall ordinarily be through Contractor. Communications by and with separate contractors shall be through DFCM.

3.1.4 A/E MAY REJECT WORK, ORDER INSPECTIONS, TESTS. The A/E shall have the authority to reject Work which, based upon the A/E's knowledge or what may be reasonably inferred from the A/E's site observations and review of data, does not conform to the Contract Documents. Whenever the A/E considers it necessary or advisable for implementation of the intent of the Contract Documents, the A/E shall have the authority to require additional inspections or testing of the Work in accordance with the provisions of the Contract Documents, whether or not such Work is fabricated, installed, or completed; however, the A/E must obtain DFCM's prior written approval of any such additional inspections or testing. Neither this authority of the A/E nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the A/E to Contractor, Subcontractors, their agents or employees or other persons performing portions of the Work, including separate contractors. If Contractor disputes the rejection of any

Work and the correction thereof shall involve additional cost or time, it shall be DFCM's option to accept such Work whether it shall be conforming or nonconforming.

3.1.5 A/E REVIEW OF CONTRACTOR'S SUBMITTALS.

3.1.5.1 Contractor shall submit Shop Drawings, Product Data, and Samples and other submittals required by the Contract Documents to the A/E as required by the approved submittal schedule.

3.1.5.2 The A/E shall review and take appropriate action upon Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the purpose of checking for conformance with the information and design concepts expressed in the Contract Documents. A/E action taken on a submittal shall not constitute a Modification.

3.1.5.3 The A/E's action shall be taken no later than fourteen (14) days following A/E's receipt of the submittal, unless agreed to otherwise by Contractor and DFCM, in order to avoid a delay in the Work of Contractor or of separate contractors while allowing sufficient time in the A/E's professional judgment to permit adequate review.

3.1.5.4 Review of such submittals shall not be conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of Contractor as required by the Contract Documents.

3.1.5.5 The A/E's review of Contractor's submittals shall not relieve Contractor of Contractor's obligations under the Contract Documents.

3.1.5.6 The A/E's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the A/E, of any construction means, methods, techniques, sequences, or procedures.

3.1.5.7 The A/E's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

3.1.5.8 When professional certification of performance characteristics of materials, systems, or equipment is the responsibility of the Contractor under the Contract Documents, the A/E shall be entitled to rely upon such certifications to establish that the materials, systems or equipment shall meet the performance criteria required by the Contract Documents.

3.2 OWNERSHIP AND USE OF A/E'S DRAWINGS, SPECIFICATIONS AND OTHER DOCUMENTS. All Drawings, Specifications, and other documents prepared by the A/E for the Work are and shall remain the property of DFCM, and DFCM shall retain all common law, statutory, and other reserved rights with respect thereto. Said documents are intended for use as an integrated set for the Work. Neither Contractor nor A/E shall modify or use Contract Documents on any other project without the prior written consent of DFCM. Any such non-permissive use or modification by Contractor, Contractor's Subcontractors at any tier, or anyone else for whose acts Contractor is liable, shall be at Contractor's sole risk. To the fullest extent permitted by law, Contractor shall release, indemnify, hold harmless, and defend DFCM, and require all Subcontractors to release, indemnify, hold harmless, and defend DFCM, from and against any and all liabilities, claims, demands, actions, damages, losses, and expenses, including but not limited to attorney fees and costs of litigation, arising out of such non-permissive use or modification by Contractor or its Subcontractors. Contractor, including its Subcontractors, are granted a limited license to use and reproduce applicable portions of the Drawings, Specifications, and other documents prepared by the A/E appropriate to and for use in the execution of the Work. Contractor shall preserve the copyright notice, if any, shown on the Drawings, Specifications and other documents prepared by the A/E for the Work, on all copies. Submittals or distributions

necessary to meet official regulatory requirements or for other purposes relating to the Work shall not be construed as a publication in derogation of DFCM's copyright or other reserved rights.

ARTICLE 4. CONTRACTOR.

4.1 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR.

4.1.1 REVIEW OF DOCUMENTS. Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by DFCM and shall at once report to DFCM and A/E all errors, omissions, inconsistencies and/or ambiguities discovered. Contractor shall not be liable to DFCM or A/E for damage resulting from errors, omissions, inconsistencies and/or ambiguities in the Contract Documents unless Contractor recognized such error, omission, inconsistency and/or ambiguity or a contractor of ordinary skill and expertise for the type of Work involved would have readily so recognized such error, omission, inconsistency and/or ambiguity, and Contractor failed to report such to DFCM and A/E. If Contractor performs any Work without such notice to DFCM and A/E and prior to resolution of the error, omission, inconsistency and/or ambiguity, Contractor shall be responsible for such performance and shall bear the costs for correction.

4.1.2 REVIEW OF FIELD CONDITIONS. Contractor shall take field measurements, verify field conditions and carefully compare such field measurements and conditions and other information known to Contractor, or information that a contractor of ordinary skill and expertise for the type of Work involved would have known, before commencing Work. Contractor shall immediately report to DFCM and A/E all errors, omissions, inconsistencies and/or ambiguities discovered. If Contractor performs any Work without such notice to DFCM and A/E and prior to resolution of the error, omission, inconsistency and/or ambiguity, Contractor shall be responsible for such performance and shall bear the costs for correction.

4.1.3 SUBSURFACE INVESTIGATIONS. If DFCM has provided the Contractor with reports of subsurface investigations and/or tests of soils at the Work site ("Geotechnical Report") as part of the Contract Documents, the Contractor may rely upon the accuracy of the technical data contained in such Geotechnical Report at the locations where the data was obtained and to the depth indicated. However, Contractor acknowledges that the conditions indicated in any Geotechnical Report of any subsurface investigations and/or tests of soils at the Work site may not be representative of conditions existing at locations and/or at depths other than where data was obtained or that conditions different than those indicated by such Geotechnical Report may exist at the Work site. Contractor shall not be entitled to any increase in the Contract Price and/or increase in the Contract Time based on any data, opinion and/or recommendation in any Geotechnical Report and/or any inaccuracy, incompleteness, mistake and/or error in any Geotechnical Report except to the extent that Contractor is entitled to an increase in the Contract Price and/or extension of the Contract Time for a concealed or unknown condition as provided in Section 7.1.5.

4.1.4 PERFORM IN ACCORDANCE WITH CONTRACT DOCUMENTS AND SUBMITTALS. Contractor shall perform the Work in accordance with the Contract Documents and submittals to which no exception has been taken in accordance with the Contract Documents.

4.1.5 PERFORMANCE TO PRODUCE THE COMPLETE SYSTEM AND INTENDED RESULTS. The Contract Documents shall be read as a whole and wherever possible, the provisions shall be construed in order that all provisions are operable. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by Contractor, whether or not specifically set forth in the Contract Documents, for the Contract Price and within the Contract Time. Performance by Contractor shall be required to the extent consistent with and reasonably inferable from the Contract Documents as being necessary to allow the Work to function for its intended use.

4.1.6 INTENT AND HIERARCHY. The Contract Documents are complimentary, and what is required by one Contract Document or provisions thereof, shall be as binding as if required by all the Contract

Documents or provisions thereof. In case of an irreconcilable conflict between provisions within a Contract Document or between Contract Documents, the following priorities shall govern as listed below:

4.1.6.1 A Modification or authorized Amendment (including authorized Supplementary Conditions) shall govern over all Contract Documents listed in Sections 4.1.6.2 – 4.1.6.6 or previous Modifications or authorized Amendments (including authorized Supplementary Conditions).

4.1.6.2 The Contractor's Agreement shall govern over all Contract Documents listed in Sections 4.1.6.3 - 4.1.6.6.

4.1.6.3 Supplemental General Conditions shall govern over all Contract Documents listed in Sections 4.1.6.4 – 4.6.1.6.

4.1.6.4 These General Conditions shall govern over the Contract Documents listed in Sections 4.1.6.5 – 4.1.6.6.

4.1.6.5 The Drawings and Specifications shall govern over the Contract Documents listed in Section 4.1.6.6.

4.1.6.6 Attachments to the Contractor's Agreement, Contractor's management plan, bidding/proposal documents, including the Instructions to Bidders/Proposers, Notice to Contractors and the Bid/Proposal Form and/or documented interview information, if any, are Contract Documents, binding on Contractor, but are subordinate to the Contract Documents listed in Sections 4.1.6.1 – 4.1.6.5.

4.1.6.7 An Addendum shall govern over all other Contract Documents and any previously issued Addendum.

4.1.6.8 In case of a conflict or ambiguity within the same level of hierarchy of described documents, DFCM reserves the right to revise the documents to select the most stringent requirement unless the preponderance of the Contract Documents indicate a less stringent requirement.

4.1.7 DIVIDING WORK AND CONTRACTOR REPRESENTATION. Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings, shall not control Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Contractor shall ensure that the Subcontractors at any tier, manufacturers and suppliers engaged or to be engaged by Contractor, are and shall be familiar with the requirements for performance by them of their obligations.

4.1.8 PLANNING AND PRIORITY. Contractor shall plan and schedule the Work and shall maintain the schedule to Substantially Complete the Work within the Contract Time.

4.2 SUPERVISION AND REPRESENTATIVES.

4.2.1 SUPERVISION AND CONTROL. Contractor shall supervise and direct the Work using Contractor's best skill and attention to complete the Work within the Contract Time. Contractor shall be solely responsible for and have control over the construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work, except to the extent that the Contract Documents specifically and expressly state otherwise.

4.2.2 PERSONS PERFORMING WORK. Contractor shall perform the Work using qualified employees, consultants, and Subcontractors selected and paid for by Contractor, adequately trained in the requirements of their particular jobs, and skilled in the Work assigned to them. Contractor shall use all

reasonable efforts to maintain a stable project team and minimize changes in key members of the team where loss of key members could have an adverse impact on the Contract Time. Any change in key personnel assigned to the Work must be approved by DFCM in writing.

4.2.3 DESIGNATED REPRESENTATIVES. Contractor shall employ a competent superintendent and necessary assistants, fluent in spoken and written English, who shall be at the Work site during performance of the Work. Contractor's superintendent shall maintain communication between DFCM, the A/E, and Contractor and be responsible for the management of Contractor's activities and deliverables described in the Contract Documents, as well as management of any third-party resources hired by Contractor to provide services or products under the Contract Documents. Contractor's superintendent shall represent Contractor, and communications given to the superintendent shall be as binding as if given to Contractor. Important communications shall be confirmed in writing. Other communications shall be similarly confirmed in writing on written request in each case.

4.2.4 DISCIPLINE AND COMPETENCE. Contractor shall enforce safety procedures, strict discipline, and good order among Contractor's employees, Contractor's Subcontractors, agents, representatives and other persons performing the Work under the Contract Documents. If DFCM reasonably determines that a particular person does not follow safety procedures, is unfit or unskilled for the assigned Work, disregards instructions, ignores the environmental restraints of the Work, or jeopardizes the goodwill between DFCM and the public, Contractor shall immediately replace the person upon receipt of DFCM's request to do so and shall not employ the person again on the Work.

4.2.5 RESPONSIBILITY. Contractor shall be responsible to the State of Utah and DFCM for the acts and omissions of Contractor's employees, Subcontractors and their agents and employees and other persons performing portions of the Work under a contract with Contractor or on behalf of Contractor.

4.2.6 NOT RELIEVED OF OBLIGATIONS. Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of DFCM or DFCM's agents in DFCM's administration of the Contractor's Agreement, or by tests, inspections, or approvals required or performed by persons other than Contractor or for those that Contractor is liable.

4.2.7 INSPECTIONS AND APPROVALS.

4.2.7.1 All Work performed by Contractor shall be subject to the inspection and approval of DFCM to determine whether the Work is in accordance with the Contract Documents. Contractor shall permit and facilitate inspection of the Work at all times by DFCM, DFCM's representatives and governmental authorities having jurisdiction.

4.2.7.2 Contractor shall be responsible for requesting inspections for various stages and portions of the Work required under the Contract Documents in a timely manner in accordance with the process and document requirements of the applicable inspection authority. In the event Work is not in a condition to be inspected at the time scheduled for the inspection of such Work for causes for which the Contractor is responsible, Contractor shall bear all associated costs and expenses without reimbursement by DFCM.

4.2.7.3 If any of the Work is required to be inspected or approved by the terms of the Contract Documents, Contractor shall timely request such inspection or approval to be performed in accordance with Article 9. Except as provided in Article 9, Work shall not proceed without any required inspection and the associated authorization to proceed. Contractor shall promptly notify DFCM if the inspector fails to appear at the site.

4.2.7.4 Contractor shall work with the inspector to maintain an Open Issues Log and Contractor shall proceed diligently to resolve all open issues.

4.3 PAYMENT BY CONTRACTOR. Except to the extent it is otherwise stated in the Contract Documents, Contractor shall provide and pay for all supervision, labor, tools, equipment, materials and transportation, including, without limitation: construction equipment and machinery; water; heat; utilities; and other facilities, supplies, consumables and services necessary for the proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

4.4 TAXES AND OTHER PAYMENTS TO GOVERNMENT. Contractor shall pay Sales Tax and/or Use Tax, consumer, employment-related and similar taxes related to the Work or portions thereof provided by Contractor which are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect. Contractor shall comply with the laws and regulations regarding the payment of Sales Tax and/or Use Tax and any exemptions. The procurement documents may have a provision regarding specific items which are exempt from State of Utah Sales Tax and/or Use Tax. Any such exemption shall be used only for the items and the project specified in the procurement documents. Any such exemption does not apply to taxes levied by the federal government or any taxing entity outside of the State of Utah. If Contractor properly relies upon a provision(s) of the bidding or proposal documents indicating exemption from State of Utah Sales Tax and/or Use Tax, and if State of Utah Sales Tax and/or Use Tax subsequently becomes due, then Contractor shall be paid such tax amount not included in the bid/proposal amount due to the reliance upon such provision.

4.5 PERMITS, FEES, NOTICES, LABOR AND MATERIALS.

4.5.1 PERMITS AND FEES. Unless otherwise required in the Contract Documents, it shall not be necessary for Contractor to obtain or pay for local building permits, plan check fees, electrical permits, plumbing permits, connection fees, or impact fees, nor shall it be necessary to pay fees for inspections pertaining thereto.

4.5.2 COMPLIANCE, NOTICES. Contractor shall comply with and give notices required by all federal, state, and local laws, rules, regulations, ordinances, and orders of public authorities applicable to the Work.

4.5.3 CORRELATION OF CONTRACT DOCUMENTS AND LAW. It is not Contractor's responsibility to ascertain that the Contract Documents are in accordance with applicable federal, state and/or local laws, rules, regulations, ordinances, and/or orders of public authorities having jurisdiction. However, if Contractor observes, or if such would be readily observable to a contractor of ordinary skill and expertise for the type of Work involved, that a portion of the Contract Documents is at variance therewith, Contractor shall promptly notify the A/E and DFCM in writing, and necessary changes shall be accomplished by appropriate Modification and/or Amendment.

4.5.4 FAILURE TO GIVE NOTICE. If Contractor, or any Subcontractor, performs Work without complying with the requirements of this Section 4.5, Contractor shall assume responsibility for such Work and shall bear the appropriate amount of the applicable costs of correction.

4.6 TIME AND CONTRACTOR'S CONSTRUCTION SCHEDULES.

4.6.1 PROGRESS AND COMPLETION.

4.6.1.1 Time is of the essence in this Contract. By executing the Contractor's Agreement, Contractor confirms that the Contract Time is adequate to perform the Work. The Contractor shall proceed expeditiously with adequate forces to achieve Substantial Completion within the Contract Time.

4.6.1.2 Contractor shall commence and complete the Work within the Contract Time and pursuant to the schedule, an initial version of which shall be prepared and provided by Contractor to DFCM and the A/E for approval, as it may be modified with DFCM's consent. Unless and except to the extent that preliminary Work at the Work site is authorized in writing by DFCM, Contractor shall not prematurely commence the Work at the Work site or elsewhere until DFCM issues a Notice to Proceed or prior to the effective date of insurance required by Article 10 to be furnished by Contractor, whichever is later. Contractor shall proceed expeditiously with adequate forces to achieve Substantial Completion within the Contract Time. All other Work shall be completed no later than the date established for Final Completion. Contractor shall notify DFCM when Contractor considers the entire Work to be completed. DFCM shall be entitled to a final inspection to determine whether the Work has been completed in accordance with the Contract Documents. The date of Substantial Completion shall be established by a certificate of Substantial Completion issued by the A/E or a written acknowledgement of Substantial Completion signed by DFCM.

4.6.1.3 INITIAL CONTRACT TIME. Unless otherwise specified in the bidding documents, the initial Contract Time shall be the time identified in the Contractor's Agreement.

4.6.2 SCHEDULE PREPARATION.

4.6.2.1 Promptly after being awarded the Work, Contractor shall prepare and submit for DFCM's and the A/E's approval, a planned progress schedule for the Work. Contractor shall plan and schedule the Work to facilitate the Work and shall maintain a schedule to place proper priority to sequence the Work to complete the Work within the Contract Time. Contractor shall commence and complete the Work by the dates set forth in the agreed upon schedule and Contractor's Agreement.

4.6.2.2 The schedule shall include a time-line for procurement, fabrication, construction, and testing activities, including interdependence of items necessary to complete the Work, duration of activities, interim completion dates, milestones, closeout and commissioning, submittals, and critical path.

4.6.2.3 Contractor shall advise and consult with DFCM during progress of the Work and keep DFCM fully informed as to the status of the Work at intervals as required by DFCM. Contractor shall provide DFCM with a daily listing of personnel and equipment used on the Work. If the Work is not on schedule, Contractor shall immediately advise DFCM in writing of Contractor's proposed action to bring it on schedule.

4.6.2.4 DFCM may take reasonable exception to activity duration, activity placement, construction logic, and time frame for any element of the Work to be scheduled and may recommend revisions.

4.6.3 SCHEDULE SUBMITTAL.

4.6.3. Contractor shall develop the CPM schedule using Primavera, MS Project or Phoenix unless otherwise authorized by DFCM. The critical path shall be identified, including the critical paths for interim completion dates and milestones.

4.6.3.2 Contractor shall update the schedule at least once a month and submit the updated schedule with each Application for Payment.

4.6.3.3 No progress payments shall be approved until Contractor has submitted a detailed CPM schedule covering the first ninety (90) days of the Work with a general CPM schedule for the entire Work. The detailed schedule for the entire Work shall be completed prior to the second Application for Payment, unless otherwise authorized in writing by DFCM.

4.6.4 SCHEDULE CONTENT REQUIREMENTS.

4.6.4.1 The schedule shall indicate the duration of activities and order, sequence and interdependence of all items known to be necessary to complete the Work, including construction, procurement, fabrication and delivery of materials and equipment, commissioning, submittals and approvals of submittals or other documents. Work items of DFCM, other contractors, utilities, and other third parties that may affect or be affected by Contractor shall be included.

4.6.4.2 If DFCM is required by the Contract Documents to furnish any materials, equipment, or other items to be incorporated into the Work by Contractor, Contractor shall submit, with the first schedule submittal, a letter clearly indicating the dates that such items are required at the Work site.

4.6.4.3 The schedule shall indicate an early Substantial Completion date for the Work that is no later than the Work's required Substantial Completion date.

4.6.4.4 The schedule, including duration of all activities, shall be given in calendar days and indicate all of the following:

4.6.4.4.1 Interfaces with the Work of outside contractors (e.g., utilities, power, and any separate contractors retained by DFCM);

4.6.4.4.2 Description of activity including activity number/numbers;

4.6.4.4.3 Estimated duration time for each activity and remaining duration;

4.6.4.4.4 Early start, late start, early finish, late finish date, and predecessor/successors including stop-start relationships with lead and lag time for each activity – all activities shall have a predecessor and a successor, except for the start milestone and finish milestone;

4.6.4.4.5 Total Float and Free Float available to each path of activities;

4.6.4.4.6 Actual start date for each activity begun;

4.6.4.4.7 Actual finish date for each activity completed;

4.6.4.4.8 The percentage complete of each activity in progress or completed;

4.6.4.4.9 Identification of all critical path activities;

4.6.4.4.10 The critical path for the Work, with the path of activities being clearly and easily recognizable on the time-scaled network diagram. The path(s) with the least amount of float must be identified. Except as may otherwise be explicitly and specifically provided in the Contract Documents, no more than forty-percent (40%) of all activities may be identified as critical path items. The relationship between non-critical activities and activities on the critical path shall be clearly shown on the network diagram. Near critical path activities shall also be identified;

4.6.4.4.11 Unless otherwise authorized by DFCM, all activities on the schedule representing construction on the site may not have a duration longer than fourteen (14) days. Construction items that require more than fourteen (14) days to complete must be broken into identifiable activities on the schedule with durations less than fourteen (14) days. The sum of these activities represents the total length required to complete that construction item; and

4.6.4.4.12 Additional requirements, if any, as specified in the Supplemental General Conditions and/or authorized Supplementary Conditions.

4.6.5 INTERIM COMPLETION DATES AND MILESTONES. The schedule must include contractually specified interim completion dates and milestones (which completion milestones must have a “finish on or before” soft constraint added). The milestones and completion dates indicated are considered essential to the satisfactory performance of the Contractor’s Agreement and to the coordination of all Work. The milestone dates listed are not intended to be a complete listing of all Work or of interfaces with other contractors.

4.6.6 FLOAT TIME. “Total Float” is defined as the amount of time that an activity can be delayed from its early without delaying Substantial Completion. “Free Float” is the amount of time that an activity can be delayed without delaying the early start date of any successor activity. Total Float time and Free Float time shall belong to the project and DFCM and Contractor have the right to use the Total Float time and/or Free Float Time for non-critical path activities until Contractor has reallocated such time on a newly submitted schedule.

4.6.7 UPDATES. Prior to any approval of an Application for Payment, DFCM, A/E, and Contractor shall review Contractor’s schedule compared to the Work completed. The amount of Work completed shall be approved by DFCM as supported by the schedule of values and as verified by the determination of Work completed. If necessary, Contractor shall then update and submit to DFCM the schedule with the Application for Payment; all of which shall be in accordance with DFCM’s approval. All updates shall be provided in electronic and hard copy formats. At each scheduled meeting with DFCM, Contractor shall provide a four week look ahead, with long lead items identified. If the Work is not on schedule, Contractor shall immediately advise DFCM in writing of Contractor’s proposed action to bring it on schedule.

4.6.8 SCHEDULE OF SUBMITTALS. Contractor shall prepare and keep current, for the A/E’s and DFCM’s review and approval, a schedule of submittals required by the Contract Documents, which shall be coordinated with Contractor’s construction schedule and allow the A/E a reasonable time to review the submittals. The submittal schedule shall be included as part of the construction schedule. Submittals requiring expedited review must be clearly identified as such in the schedule of submittals. Contractor shall coordinate and agree upon a submittal schedule with A/E. If a submittal does not pass a second review, then a meeting will be held to determine a path to proceed and expedite approval. Contractor shall notify A/E in writing if expedited review of a submittal is critical.

4.6.9 SCHEDULE RECOVERY. If the Work represented on the critical path falls behind more than seven (7) days, Contractor shall redo the schedule within seven (7) days, showing how the Contractor shall recover the time. Contractor’s schedule must have an approved baseline schedule before the schedule may be updated. A narrative that addresses the changes in the schedule from the previously submitted schedule shall be submitted along with the updated schedule in electronic .pdf format and on the written request of DFCM in native electronic copy format of the scheduling software utilized by Contractor. Contractor shall comply with the most recent schedules.

4.6.10 SCHEDULE CHANGES.

4.6.10.1 The Contract Time may only be shortened or extended by a Change Order or Construction Change Directive.

4.6.10.2 Should Contractor, after approval of the complete detailed construction schedule, desire to change Contractor's plan of construction, Contractor shall submit its requested revisions to DFCM and the A/E, along with a written statement of the revisions including a description of the sequence and duration changes for rescheduling the Work, methods of maintaining adherence to intermediate milestones and the completion dates, and the reasons for the revisions. Requested changes to the approved baseline schedule shall include a narrative that addresses the requested changes. If the requested changes are acceptable to DFCM, which acceptance shall not be unreasonably withheld, they shall be incorporated into the schedule in the next reporting period by Contractor. If after Contractor submits a request for change in the schedule, DFCM does not agree with the request, DFCM shall schedule a meeting with Contractor to discuss the differences.

4.6.10.3 The critical path schedule, as the term is used in these General Conditions, shall be based on the current version of Contractor's schedule for the Work and accepted by DFCM just prior to the an asserted change in the Work, asserted delay, suspension, or interruption. If Contractor believes it is entitled to an extension of Contract Time under the Contract Documents, Contractor shall submit a PCO in accordance with Section 7.2 to the A/E and DFCM accompanied by an analysis ("Requested Time Adjustment Schedule") in accordance with the Contract Documents for time extensions. The "Requested Time Adjustment Schedule" shall include "fragnets" that represent the added or changed Work to the schedule. The impact on unchanged activities caused by the changes and/or delays being analyzed shall be included in these fragnets. A "fragnet" as used in these General Conditions and when used in the context of project scheduling is a subset of project activities that are inter-related by predecessor and successor relationships that are tied into the main schedule with identified start and completion points. Each fragnet may or may not be on the critical path. An entire schedule consists of a series of inter-related fragnets.

4.6.11 EXCUSABLE DELAY.

4.6.11.1 If Contractor is unreasonably delayed in the progress of the Work on the critical path schedule by an act or neglect of DFCM; or separate contractors retained by DFCM; or by a Force Majeure Delay (defined below) that DFCM reasonably determines may justify delay beyond the date for Substantial Completion, then the Contract Time shall be extended by Change Order for the period of time caused by such delay. The Contract Price shall not be increased, and the Contract Time shall not be extended for any delays that are concurrent with Contractor delays.

4.6.11.1.1 For purposes of the Contractor's Agreement, a Force Majeure Delay shall mean a delay to the commencement or the progress of the Work by reason of events or causes beyond the control of DFCM, the Contractor, and the Contractor's Subcontractors and Sub-subcontractors of any tier, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable. Notwithstanding anything to the contrary set forth herein, Force Majeure Delays shall not include: (1) labor disputes confined to the Work site or relating solely to the Work that are due to a breach of a collective bargaining agreement by the Contractor or its Subcontractors or Sub-subcontractors of any tier, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable; (2) adverse weather conditions, except as provided in Section 4.6.11.2; (3) a failure of the Contractor or its Subcontractors or Sub-subcontractors of any tier, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable, to comply with any laws, codes or orders of governmental authorities with jurisdiction of the Work; or (4) any financial inability of the Contractor or its Subcontractors or Sub-subcontractors of any tier, or anyone directly or indirectly employed by them, to perform their obligations under the Contract Documents.

4.6.11.1.2 Delays which according to the schedule do not affect any critical path milestone dates or the completion dates shown on the schedule at the time of the delay shall not be the basis for a change in the Contract Time.

4.6.11.1.3 Contractor shall immediately take all steps reasonably possible to lessen the adverse impact of delay. Notwithstanding the foregoing, to the extent any of the causes for delay were caused by Contractor, reasonably foreseeable by Contractor, or avoidable by Contractor, then to such extent the delay shall not be cause for a change in the Contract Price and/or Contract Time. For purposes of this Section, “Contractor” shall include all Subcontractors and others under the responsibility of the Contractor.

4.6.11.1.4 The determination of the total amount of time extension, if any, shall be based upon the current schedule in effect at the inception of the change and/or delay and upon all data relevant to the extension as supported by appropriate substantiating relative data in the project record. Once approved, such data shall be incorporated in the next monthly update of the schedule by Contractor.

4.6.11.2 The Contract Price shall not be increased and the Contract Time shall not be extended for normal bad weather or any weather that is reasonably foreseeable at the time of entering into the Contractor’s Agreement. The Contract Time as stated in the Contract Documents includes due allowance for days on which Work cannot be performed out of doors. Contractor acknowledges that Contractor may lose days due to weather conditions. The Contract Time may be extended at no cost to DFCM if all of the following are met, which must be established by Contractor:

4.6.11.2.1 That the weather prevented Work from occurring that is on the critical path for the Work based upon a critical path schedule previously submitted to DFCM and to the extent accepted by DFCM;

4.6.11.2.2 There are no concurrent delays for which Contractor is responsible;

4.6.11.2.3 Contractor took all reasonable steps to alleviate the impact of the weather and made reasonable attempts to prevent the delay and despite such reasonable actions of Contractor, the weather impacted the critical path as described above; and

4.6.11.2.4 In connection with the weather event for which delay is claimed by Contractor, the weather was either exceptionally adverse, such as a tornado, severe wind storm, or severe hail storm, or one of the following occurred:

4.6.11.2.4.1 for any day between November 1 and March 31 for which delay is claimed by Contractor, the recorded minimum temperature at the Work site, as verifiably documented by Contractor, fell below the mean minimum temperature for the station closest to the Work site (“Proximate Station”) for the applicable month according to the Western Regional Climate Center Website, <http://www.wrcc.dri.edu/summary> (“WRCCW”), as shown on the *Average of Minimum Temperature* chart on the WRCCW for the Proximate Station, less the mean extreme minimum temperature for the Proximate Station for the applicable month, as shown on the *Minimum of Minimum Temperature Chart* on the WRCCW for the Proximate Station, divided by Two (2);

4.6.11.2.4.2 for any day between November 1 and March 31 for which delay is claimed by Contractor, the recorded maximum temperature at the Work site, as verifiably documented by Contractor, fell below the mean minimum temperature as shown on the *Average of Minimum Temperature* chart on the WRCCW for the Proximate Station;

4.6.11.2.4.3 for any day for which delay is claimed by Contractor, the recorded precipitation at the Work site, as verifiably documented by Contractor, exceeded seventy-five percent (75%) of the daily extreme for the applicable month as shown on the *POR – Daily Precipitation Average and Extreme* chart on the WRCCW for the Proximate Station;

4.6.11.2.4.4 for any day for which delay is claimed by Contractor, the recorded snowfall at the Work site, as verifiably documented by Contractor, exceeded seventy-five percent (75%) of the daily extreme for the applicable month as shown on the *POR – Daily Snowfall Average and Extreme* chart on the WRCCW for the Proximate Station.

4.6.12 COMPENSABLE DELAY, SUSPENSION OR INTERRUPTION.

4.6.12.1 In addition to the other requirements of the Contract Documents, a compensable delay, suspension, or interruption of the Work occurs only when the following conditions are met:

4.6.12.1.1 The delay is caused by DFCM for a reason not permitted by the Contract Documents; and

4.6.12.1.2 Contractor delivers a written notice to the A/E and DFCM within seven (7) days that Contractor knows or should have known of the condition giving rise to the purported compensable delay, suspension, or interruption, and the condition affects the Contract Time as indicated by the last agreed upon critical path schedule.

4.6.12.2 To the extent of the compensable delay, Contractor's total entitlement for all compensable delay damages is the computed result of the following formula: Contract Price divided by Contract Time (in calendar days); the result of which is then multiplied by 0.05; and the result of which is multiplied by the number of calendar days of compensable days allowed under these General Conditions that are beyond the Contract Time. Notwithstanding any other provision of these General Conditions or the Contract Documents, to the extent Contractor is entitled to receive a markup under Sections 7.4.2.5.1 or 7.4.2.5.2 this provision shall be inapplicable, and the markup shall be deemed to include all the compensable delay damages provided by this Section.

4.6.12.3 The length and extent of compensable delay shall be determined, with the use of the Work's critical path schedule by ascertaining the number of additional days added to the Contract Time are needed in order to perform the Work in accordance with the Contract Documents as a result of the delay, suspension, or interruption after receipt of the written notice received by the A/E and DFCM under Section 4.6.12.1.2.

4.6.12.4 Notwithstanding any other provision of these General Conditions, to the extent a non-compensable delay occurs at the same time as a compensable delay, DFCM shall not be responsible for any compensation to Contractor and the Contract Price shall not be increased for the period of the non-compensable delay.

4.6.13 **TIME EXTENSION REQUESTS.** Contractor shall notify DFCM within seven (7) days of a potential delay and Contractor shall request any and all Contract Time extensions within twenty-one (21) days after Contractor knew or should have known about the delay. Contractor must support any request for a Contract Time extension with a critical path schedule analysis.

4.6.14 LIQUIDATED DAMAGES.

4.6.14.1 Time is of the essence in the Contract Documents. DFCM will suffer damages that are difficult to ascertain for each calendar day the date for Substantial Completion is delayed. Therefore, as agreed damages and not as a penalty, DFCM may offset from any payments due Contractor the sum stated in the Contractor's Agreement, as augmented in Section 4.6.14.2 in the case of continuing delay, for each day Substantial Completion is delayed beyond the date established for Substantial Completion of the Work by the Contract Documents.

4.6.14.2 For each day subsequent to the fourteenth (14th) day after the date established for Substantial Completion of the Work by the Contract Documents, the liquidated damages amount stated in the Contractor's

Agreement shall be increased by ½ percent (0.5%) of the amount stated in the Contractor's Agreement for each day Substantial Completion is delayed beyond the date established for Substantial Completion of the Work by the Contract Documents.

4.6.14.3 The sum for liquidated damages due DFCM by Contractor has been agreed upon by reason of the inconvenience and added costs of administration, engineering, supervision, and other expenses resulting from Contractor's default.

4.6.14.4 To the extent liquidated damages exceed any amounts that would otherwise be due Contractor, Contractor shall be liable for such excess to DFCM.

4.6.14.5 Notwithstanding any other provision of these General Conditions, the availability of liquidated damages to DFCM shall not limit DFCM's right to seek damages or other remedies available under law or equity to the extent such damages or remedies are not based upon delay.

4.6.15 NO WAIVER OF DFCM'S RIGHTS. Permitting Contractor to continue any part of the Work after the time fixed for completion or beyond any authorized extension thereof shall in no way operate as a waiver or estoppel on the part of DFCM of any of its rights under the Contract Documents, including the right to liquidated damages or any other remedies or compensation.

4.7 DOCUMENTS AND SAMPLES AT THE SITE, CERTIFYING "AS-BUILTS". Contractor shall maintain at the Work site one record copy of the Drawings, Specifications, Addenda, authorized Amendments and Modifications, in good order and marked weekly to record changes and selections made during construction, as well as approved Shop Drawings, Product Data, Samples and similar submittals. These items shall be available to the A/E and shall be delivered to the A/E for submittal to DFCM upon completion of the Work, signed by Contractor, certifying that they show complete and exact "as-built" conditions, stating sizes, kind of materials, piping, conduit locations, and similar matters. All notes of encountered or changed conditions shall be included.

4.8 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

4.8.1 NOT CONTRACT DOCUMENTS. Shop Drawings, Product Data, Samples and other submittals are not Contract Documents. The submittal shall demonstrate, for those portions of the Work for which the submittal is required, the way Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

4.8.2 PROMPTNESS. Contractor shall coordinate submittals prepared by Subcontractors and Sub-subcontractors, review, approve, and submit to the A/E, Shop Drawings, Product Data, Samples and other submittals required by the Contract Documents with reasonable promptness and according to an agreed submittal schedule in such sequence as to cause no delay in the Work, or the activities of DFCM, or separate contractors.

4.8.3 NOT PERFORM UNTIL A/E APPROVES. Contractor shall not perform any portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples, mock-ups where required or other submittals (including deferred submittals) until the applicable submittal has been approved in writing by the A/E. Contractor shall perform the Work in accordance with the approved submittals. Submittals marked "No-exceptions taken" or its equivalent by the A/E are considered approved for purposes of this Section 4.8.3.

4.8.4 REPRESENTATIONS BY CONTRACTOR. By approving and submitting Shop Drawings, Product Data, Samples, and other submittals, Contractor represents that Contractor has determined and verified materials, field measurements, field construction criteria, manufacturer installation instructions and

procurement and delivery dates related thereto and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

4.8.5 CONTRACTOR'S LIABILITY. Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the A/E's approval of Shop Drawings, Product Data, Samples, or similar submittals unless Contractor has specifically informed the A/E in writing of such deviation at the time of the submittal and the A/E has given written approval to the specific deviation. Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or other submittals by the A/E's review and approval.

4.8.6 DIRECT SPECIFIC ATTENTION TO REVISIONS. Contractor shall direct specific attention in writing to all revisions on resubmitted Shop Drawings, Product Data, Samples, or other submittals, except those requested by the A/E and indicated on previous submittals.

4.8.7 INFORMATIONAL SUBMITTALS. Informational submittals upon which the A/E is not expected to take responsive action may be so identified in the Contract Documents.

4.8.8 PROFESSIONAL SERVICES. The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, DFCM and the A/E will specify performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed Design Professional (as that term is defined in Section 4.8.8.1 of these General Conditions), whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Each Design Professional providing such services shall carry professional errors and omissions insurance in an amount of at least Two Million Dollars (\$2,000,000.00) per claim/annual aggregate with a deductible or self-insured retention of not greater than One Hundred Thousand Dollars (\$100,000.00), unless different amounts are authorized by DFCM in writing. Shop Drawings and other submittals related to the Work designed or certified by such Design Professional, if prepared by others, shall bear such Design Professional's written approval when submitted to the A/E. DFCM and the A/E shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such Design Professional, provided DFCM and A/E have specified to the Contractor performance and design criteria that such services must satisfy. Pursuant to this Section 4.8, the A/E will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

4.8.8.1 A "Design Professional" is any and all employees or independent contractors directly or indirectly employed by the Contractor, a Subcontractor or a Sub-subcontractor of any tier to perform any professional design services required by the Contract Documents. The Contractor or its Subcontractors or Sub-subcontractors of any tier employing the Design Professional shall require the Design Professional to agree in writing to be bound by the terms of the Contract Documents insofar as they apply to the design services of the Design Professional in the performance of the Work.

4.8.8.2 The Contractor hereby assigns to DFCM all common law, statutory and other rights that the Contractor may have in the drawings, specifications and other documents prepared by the Design Professional for the Work (the "Design Documents"), including all copyrights. The Contractor shall endeavor to obtain a similar assignment to DFCM by the Design Professional and by the Subcontractors or Sub-subcontractors of

any tier employing the Design Professional of their common law, statutory and other rights (including copyrights) in the Design Documents. At the date of final payment or upon the earlier termination of the Contractor's Agreement, the Contractor shall promptly deliver to DFCM hardcopy originals of all Design Documents and all Design Documents in reproducible (not read only) electronic media.

4.8.8.3 The Contractor shall require and hereby represents and warrants to DFCM that the Design Professional is appropriately registered with and licensed by the State of Utah to perform the services required by the Contract Documents to be performed by the Design Professional.

4.8.8.4 All services provided by the Design Professional shall be performed consistent with the professional skill and care ordinarily provided by other design professionals: (1) with the same or similar license; and (2) providing the same or similar design professional service (A) in the same or similar locality, (B) at the same or similar time and (C) under the same or similar circumstances, provided that, if the nature of the project reasonably requires specialized design expertise, the Design Professional shall perform design professional services consistent with such specialized design expertise.

4.8.8.5 Notwithstanding any approval of DFCM or A/E of any Design Documents, the Contractor shall be responsible for assuring that all Design Documents (whether prepared by a Design Professional employed by the Contractor, a Subcontractor or a Sub-subcontractor of any tier) are technically adequate and accurate and are in accordance with all laws, ordinances, codes, regulations or other requirements of governmental authorities having jurisdiction of the Work applicable to the Work on the day of the issuance of such documents and on the day of the use of such documents on the Work.

4.8.8.6 The Contractor shall be responsible and liable to DFCM for any and all losses, costs, and/or expenses incurred by DFCM arising out of, related to and/or connected with errors or omissions in the services provided hereunder by the Design Professional, to the extent that such errors or omissions were caused by the failure of the Design Professional to perform services consistent with the requirements of Section 4.8.8.4 or by other fault of the Design Professional, whether or not such losses, costs and/or expenses were caused by any negligence or other fault of the Contractor. This responsibility and liability shall survive completion of the Work or termination of the Contractor's Agreement.

4.8.8.7 The Contractor shall indemnify and hold harmless DFCM and the other Indemnified Parties (as defined in Section 4.12) from and against any and all third-party claims, demands, losses, liabilities, judgments, costs, expenses and/or attorney fees arising of, related to and/or connected with errors or omissions in the services provided hereunder by the Design Professional, to the extent that such errors or omissions were caused by the failure of the Design Professional to perform services consistent with the requirements of Section 4.8.8.4 or by other fault of the Design Professional, whether or not such third-party claims, demands, losses, liabilities, judgments, costs, expenses and/or attorney fees were caused by any negligence or other fault of the Contractor. This indemnity is in addition to the indemnity provided in Section 4.12 and shall survive completion of the Work or termination of the Contractor's Agreement.

4.8.8.8 The Contractor's or its Subcontractor's or Sub-subcontractor of any tier's agreement with the Design Professional for design services in the performance of the Work shall state that DFCM and its successors and assigns are intended third-party beneficiaries of such agreement and such agreement with the Design Professional shall require the Design Professional to deliver to DFCM a separate agreement wherein the Design Professional shall expressly contract with DFCM to provide the Design Professional's professional services consistent with the standard of care established by Section 4.8.8.4.

4.8.8.9 The Contractor shall indemnify, defend and hold harmless DFCM and the other Indemnified Parties (as defined in Section 4.12 of these General Conditions) from and against any and all claims, demands, losses, liabilities, judgments, costs, expenses and/or attorney fees caused by any suits or claims of infringement of any patent rights or copyrights for materials, methods or systems depicted upon or required by Design Documents

prepared by the Design Professional. This indemnity is in addition to the indemnity provided in Sections 4.11 and 4.12 of these General Conditions and shall survive completion of the Work or termination of the Contractor's Agreement.

4.9 USE OF SITE.

4.9.1 IN GENERAL. Contractor shall confine its equipment, the storage of materials, and the operations of its workers at the Work site to areas permitted by the Contract Documents, laws, rules, regulations, ordinances, orders, and permits and shall not unreasonably encumber the Work site with materials or equipment. Contractor shall take all reasonable steps to secure the Work site and protect the Work from any damage. Upon completion of the Work, Contractor shall leave the Work site free and clear of all waste materials, rubbish, tools, equipment, and surplus materials. Contractor shall at all times keep the Work site free from spilled liquids and chemicals, toxic or otherwise. If such a spill occurs while Contractor has control of the Work site, Contractor shall be responsible to clean the affected areas on or about the Work site and pay all associated costs, fines, and penalties. Notwithstanding the foregoing, Contractor shall not be responsible for any damage to the Work site or the Work to the extent caused by DFCM or DFCM's agents.

4.9.2 ACCESS TO NEIGHBORING PROPERTIES.

4.9.2.1 Contractor shall not, except as provided in the Contract Documents or with DFCM's advance written consent when necessary to perform the Work, interfere with access to properties neighboring the Work site by the owners of such properties and their respective tenants, agents, invitees and guests.

4.9.2.2 Various federal, state, and local agencies and private landowners may own or control lands and facilities either crossed by or adjacent to the Work site. DFCM shall secure and pay for all necessary rights of access to the Work site. Contractor shall comply with all stipulations provided by DFCM and shall maintain a cooperative relationship with all agencies and landowners. Contractor shall not retain on the Work site any person who in the judgment of DFCM prejudices or tends to endanger this cooperation. Contractor shall not enter into any agreement with such agencies or landowners related to the Work without prior approval by DFCM.

4.10 ACCESS TO WORK. Contractor shall provide DFCM and the A/E access to the Work in preparation and progress, at all times and wherever located.

4.11 INTELLECTUAL PROPERTY LICENSES. Contractor shall obtain and pay for all royalties and other license fees for all equipment, property, or processes of Contractor used or purchased in connection with performance of the Work. Contractor shall defend suits or claims for infringement of intellectual property rights and shall hold DFCM and the A/E harmless from loss on account thereof but shall not be responsible for such defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents. However, if Contractor has reason to believe that the required design, process or product is an infringement of any third party's intellectual property right, Contractor shall be responsible for such defense or loss unless such information is promptly furnished to DFCM in writing.

4.12 INDEMNIFICATION. To the fullest extent permitted by law, Contractor shall release, indemnify, hold harmless, and defend the State of Utah, the State of Utah's institutions, agencies (including, but not limited to, DFCM), departments, divisions, authorities, and instrumentalities, boards, commissions, elected or appointed officers, employees, agents and authorized volunteers (collectively "Indemnified Parties") from and against any and all claims, liabilities, demands, actions, damages, losses and expenses of any nature whatsoever, including, but not limited to, attorneys' fees and defense costs (collectively "Liabilities"), and including those events covered under the blanket Contractual Liability Coverage required under the Contract Documents, arising out of, related to, or connected with any act or omission in the performance of the Work, including the Work of all Subcontractors and their employees, provided that any Liabilities are caused in whole or in part by

the negligent, intentional, or other wrongful act or omission of Contractor, any Subcontractor, their employees, or anyone directly or indirectly employed or the agent of any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by an Indemnified Party. Without relieving Contractor of any obligation under the Contract, the Indemnified Parties shall have the right, at their option, to fully participate in the investigation, defense and settlement of any Liabilities.

4.12.1 NOT EXCLUSIVE. The foregoing obligations in this Section 4.12 shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person under the Contract Documents.

4.12.2 NOT LIMITED. The foregoing obligations in this Section 4.12 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or Subcontractor under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

ARTICLE 5. SUBCONTRACTORS.

5.1 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK.

5.1.1 SUBCONTRACTING WORK PERMITTED; CONDITIONS.

5.1.1.1 Contractor may subcontract portions of the Work.

5.1.1.2 DFCM reserves the right to reject on reasonable ground any Subcontractor. Contractor shall not contract with any person or entity to whom DFCM has made reasonable objection. Contractor shall not be required to contract with anyone to whom Contractor has made reasonable and timely objection, provided that any additional costs associated with Contractor replacing a Subcontractor objected to by Contractor with a replacement Subcontractor not objectionable to Contractor shall be at no cost to DFCM.

5.1.2 SUBSEQUENT CHANGES. After execution of Contractor's Agreement Subcontractors listed by Contractor in accordance with Utah Code § 63A-5b-605 and Rule R23-1-615 may be changed by Contractor only in accordance with the requirements of Utah Code § 63A-5b-605 and R23-1-615.

5.1.2.1 DFCM shall pay the additional costs for a DFCM-requested change in Subcontractor if all of the following conditions are met:

5.1.2.1.1 If DFCM in writing requests the change of a Subcontractor;

5.1.2.1.2 The original Subcontractor is a responsible subcontractor that meets the requirements of the Contract Documents; and

5.1.2.1.3 The original Subcontractor did not withdraw as a Subcontractor on the Work.

5.1.2.2 In all other circumstances, Contractor shall pay the additional cost for a change in a Subcontractor.

5.1.3 BUSINESS AND LICENSING REQUIREMENTS. All Subcontractors used by Contractor shall have secured, at their own expense, all necessary professional accreditations, registrations, and licenses in the state of Utah.

5.1.4 BONDING OF SUBCONTRACTORS. Subcontractors, as identified by DFCM in the procurement documents, may be required to submit performance and payment bonds to cover the full extent of

their portion of the Work. This provision does not in any way limit the right of Contractor to have Subcontractors at any tier be required to have a performance and/or payment bond at Contractor's expense.

5.1.5 SUBCONTRACTOR DEFAULT INSURANCE. If the Contract Price includes any amount to compensate the Contractor for Subcontractor Default Insurance ("SDI"), then, notwithstanding anything in the Contract Documents to the contrary:

5.1.5.1 DFCM shall be added to the SDI by a financial interest endorsement reasonably acceptable to DFCM at no cost to DFCM;

5.1.5.2 If the Contract Documents provide for Contractor contingency, no Contractor contingency may be expended for any Subcontractor default or for any expenses and/or losses arising out of, connected with and/or related to any Subcontractor default;

5.1.5.3 Contractor shall in no event be entitled to an increase in the Contract Price and/or extension of the Contract Time for a Subcontractor default or for expense, losses and/or delays arising out of, connected with and/or related in any way to a Subcontractor default; and

5.1.5.4 The cost of SDI is included in Contractor's overhead and profit for purposes of Article 7.

5.2 SUBCONTRACTUAL RELATIONS.

5.2.1 CONTRACTOR FULLY RESPONSIBLE. Subcontracting any portion of the Work shall not relieve Contractor of Contractor's obligations or duties under the Contract Documents, Contractor shall be fully responsible and liable to DFCM for the acts and omissions of all Subcontractors at any tier and their employees and agents and Contractor shall maintain complete control over all Subcontractors. Neither the consent of DFCM to a Subcontractor proposed by Contractor, nor anything contained in the Contract Documents shall be deemed to create a contractual relationship between a Subcontractor at any tier and DFCM.

5.2.2 COMPLY WITH CONTRACT DOCUMENTS. By appropriate enforceable agreement Contractor shall require each Subcontractor to be bound to Contractor by the terms of the Contract Documents, and to assume toward Contractor all the obligations and responsibilities that Contractor, by the Contract Documents, assumes towards DFCM and the A/E.

5.2.3 RIGHTS. Each Subcontractor agreement shall preserve and protect the rights of DFCM under the Contract Documents with respect to that portion of the Work to be performed by the Subcontractor so that subcontracting any portion of the Work shall not prejudice any rights of DFCM under the Contract Documents, and shall allow to the Subcontractor, unless specifically provided otherwise in the Subcontractor agreement, the benefit of all rights and remedies against Contractor that Contractor, by the Contract Documents, has against DFCM.

5.2.4 SUB-SUBCONTRACTORS. Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors and to require such Sub-subcontractors to enter into similar agreements with lower tier Sub-subcontractors that comply with the requirements of Sections 5.2.2 and 5.2.3.

5.2.5 DOCUMENT COPIES. Contractor shall make available to each proposed Subcontractor, prior to execution of the Subcontractor agreement, copies of the Contract Documents to which the Subcontractor shall be bound. Contractor shall require Subcontractors to make copies of applicable portions of the Contract Documents available to their respective proposed Sub-subcontractors.

5.3 CONTINGENT ASSIGNMENT OF SUBCONTRACTS TO DFCM. Contractor contingently assigns each Subcontractor agreement with a Subcontractor for a portion of the Work to DFCM, provided that

the assignment is effective only after termination of the Contractor's Agreement by DFCM for cause pursuant to Section 12.2 or stoppage of the Work by DFCM pursuant to Section 12.5, and only for those Subcontractor agreements that DFCM accepts by notifying the Subcontractor in writing. Contractor shall remain liable for all obligations incurred under assigned Subcontractor agreements prior to DFCM's acceptance of such assignment.

ARTICLE 6. PROTECTION OF PERSONS AND PROPERTY.

6.1 SAFETY OF PERSONS AND PROPERTY.

6.1.1 CONTRACTOR RESPONSIBILITY. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Work. Contractor shall seek to minimize the risk of bodily injury, property damage, and environmental harm by taking all reasonable precautions to protect:

6.1.1.1 All persons at and/or in proximity to the Work site;

6.1.1.2 Materials and equipment to be incorporated in the Work, whether in storage on or off the Work site, under the care, custody, or control of Contractor or a Subcontractor;

6.1.1.3 Property and structures located at the Work site and adjacent to the Work site, whether or not such property and structures are part of the Work, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction; and

6.1.1.4 The environment.

6.1.2 SAFETY PROGRAM, PRECAUTIONS. Contractor shall institute and provide to DFCM a project specific safety program at the start of the Work to minimize accidents. The program shall continue to the final completion of the Work and conform to applicable laws, rules, and regulations. including without limitation. the Utah Occupational Safety and Health Rules as published by the Utah Labor Commission - UOSH Division at Utah Administrative Code, R614. Contractor shall post signs, erect barriers, and provide those items necessary to implement the safety program. As soon as Contractor proceeds with the Work, Contractor shall have all workers and all visitors on the Work site wear safety hard hats, as well as all other appropriate safety apparel such as safety glasses and shoes, and obey all safety laws, rules, and regulations. Contractor shall post a sign in a conspicuous location indicating the necessity of wearing hard hats, and Contractor shall loan such hard hats to visitors. Contractor shall maintain a clean and orderly Work site.

6.1.3 COMPLIANCE WITH LAWS. Contractor shall give notices and comply with applicable laws, rules, regulations, ordinances, and orders of public authorities applicable to the safety of persons and property and their protection from damage, injury and loss. In particular, Contractor shall comply with all applicable provisions of federal, state and municipal safety laws, rules and regulations, specifically including, without limitation, building codes, to prevent accidents and injury to persons on, about or adjacent to the Work site.

6.1.4 ERECT AND MAINTAIN SAFEGUARDS. As required by existing conditions at the Work site and proper and safe performance of the Work, Contractor shall erect and maintain safeguards for safety and protection, including effective fences, danger signs, barricades and other warnings against hazards. Contractor shall also promulgate safety regulations and notify owners and users of adjacent sites and/or utilities before performing Work that may impact such adjacent sites and/or utilities.

6.1.5 UTMOST CARE. When use or storage of explosives or other dangerous materials or equipment or unusual methods are necessary for execution of the Work, Contractor shall exercise utmost care and carry on such activities under the supervision of properly qualified personnel.

6.1.6 PROMPT REMEDY. Contractor shall promptly remedy any damage and loss (other than damage or loss insured under property insurance required by Section 10.2) to persons, property and/or the environment arising in conjunction with the Work caused in whole or in part by Contractor, Subcontractors, or any person or entity for whose acts Contractor is responsible, without cost or expense to DFCM.

6.1.7 SAFETY DESIGNEE. Contractor shall designate a responsible member of Contractor's organization at the Work site whose duty shall be the prevention of accidents, damage, injury and loss. This person shall be Contractor's superintendent, unless otherwise designated by Contractor in writing to DFCM and the A/E.

6.1.8 LOAD SAFETY. Contractor shall not load or permit any part of the construction or Work site to be loaded so as to endanger its safety and/or the safety of persons at or in the vicinity of the Work site.

6.1.9 OFF-SITE RESPONSIBILITY. In addition to its other obligations under this Article 6, the Contractor shall, at Contractor's sole cost and expense, promptly repair any damage or disturbance to walls, utilities, streets, ways, sidewalks, curbs and the property of the State and third parties (including municipalities and other governmental agencies) resulting from the performance of the Work, whether by Contractor or by Contractor's Subcontractors at any tier. The Contractor shall not cause materials, including soil and debris, to be placed or left on streets or ways.

6.1.10 EMERGENCIES. In an emergency affecting safety of persons or property, Contractor shall act, at Contractor's discretion, to prevent threatened damage, injury or loss. Contractor shall promptly notify DFCM of the action taken.

6.2 HAZARDOUS MATERIALS. In the event Contractor encounters at the Work site material reasonably believed to be asbestos, polychlorinated biphenyl (PCB), or any other hazardous waste or substance that may endanger the health of persons performing Work or being at the Work site that is not part of the Work and/or disclosed by the Contract Documents, Contractor shall immediately stop Work in the area affected and immediately report the condition to DFCM and the A/E by phone with a follow-up email. Contractor shall resume the Work in the affected area upon written direction provided by DFCM. Except to the extent provided otherwise in the Contract Documents, or if the presence of hazardous materials is due to the fault of Contractor, Contractor shall not be required to perform, without Contractor's consent, any Work relating to asbestos, polychlorinated biphenyl (PCB), or any other hazardous waste or substance.

6.3 HISTORICAL AND ARCHEOLOGICAL CONSIDERATIONS. In the event Contractor discovers any cultural, historical, or archeological material that is either recognized as an item to be protected under federal, state, or local law or regulation, or is an item of obvious value to the State of Utah, Contractor shall cease any Work that would interfere with such discovery and immediately report the condition to DFCM and the A/E by phone with a follow-up email. Contractor shall resume the Work upon the direction of DFCM. Contractor shall ensure cooperation with any DFCM-recognized archaeologist or other cultural/historical expert.

6.4 CONTRACTOR LIABILITY. If Contractor fails in any of its obligations in Sections 6.2 through 6.3, Contractor shall be liable for any damages to DFCM, the State of Utah, or any third party resulting from such noncompliance. Contractor shall also be liable for any mitigation or restoration effort resulting from such noncompliance. To the extent all the following is met, the presence of hazardous material or cultural, historical, or archeological material at the Work site shall qualify as a concealed or unforeseen condition under Section 7.1.5:

6.4.1 The presence of such material is not reasonably foreseeable given the site conditions that Contractor is or should have been aware of;

- 6.4.2** The presence of such material is not identified in any part of the Contract Documents;
- 6.4.3** Contractor has undertaken all proper action to mitigate any impact of the discovery of such material on the Contract Time and/or Contract Price;
- 6.4.4** The discovery of such material increases the Contract Time and/or Contract Price from what is stated in the Contract Documents; and
- 6.4.5** The requirements of Section 7.1.5 and the Contract Documents are met.

ARTICLE 7. MODIFICATIONS, PRs & PCOs, PRE AND CLAIM PROCESS.

7.1 MODIFICATIONS: IN GENERAL.

7.1.1 TYPES OF MODIFICATIONS AND LIMITATIONS. Changes in the Work may be accomplished after execution of the Contractor's Agreement, and without invalidating the Contract Documents, by ASI, Change Order or Construction Change Directive, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents. Contractor must have a written Change Order or Construction Change Directive executed by DFCM under this Article 7 prior to proceeding with any Work for which Contractor intends to request an increase in the Contract Price and/or an extension of the Contract Time.

7.1.2 BY WHOM ISSUED. The A/E or DFCM may issue ASIs not involving an adjustment in the Contract Price or an extension of the Contract Time which are not inconsistent with the intent of the Contract Documents. A Change Order or Construction Change Directive shall be issued by DFCM. The A/E shall prepare Change Orders and Construction Change Directives with specific documentation and data for DFCM's approval and execution in accordance with the Contract Documents.

7.1.3 CONTRACTOR TO PROCEED UNLESS OTHERWISE STATED. Changes in the Work shall be performed under applicable provisions of the Contract Documents, and Contractor shall proceed promptly, unless otherwise provided in the ASI, Change Order or Construction Change Directive.

7.1.4 ADJUSTING UNIT PRICES. If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a proposed Change Order or Construction Change Directive that application of such unit prices to quantities of Work proposed shall cause a substantial inequity to DFCM or Contractor, the applicable unit prices may be equitably adjusted.

7.1.5 CONCEALED OR UNKNOWN CONDITIONS. Contractor must file a written notice with DFCM within seven (7) calendar days of the date that Contractor knew or should have known of a site condition described below or Contractor shall be deemed to waive any right to file any PCO, PRE, or Claim for an increase in the Contract Price and/or extension of the Contract Time related to such condition:

7.1.5.1 If Contractor encounters unknown and reasonably unforeseeable subsurface or otherwise concealed physical conditions, including hazardous or historical/cultural/archeological materials under Article 6, which differ materially from those indicated by the Contract Documents or which would have been revealed by a reasonably thorough site inspection; or

7.1.5.2 If Contractor encounters unknown physical conditions of an unusual nature which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents.

7.1.6 INCREASE IN CONTRACT TIME. To the extent DFCM and/or the State of Utah is damaged by the failure of Contractor to provide the notice required by Section 7.1.5 after the Contractor knows or should

have known of such site condition, Contractor shall be liable for liquidated damages attributable thereto, as well as any damages to the State of Utah and/or DFCM that are allowable in addition to liquidated damages.

7.1.7 ALLOWANCES.

7.1.7.1 The Contractor has included in the Contract Price all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as DFCM may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

7.1.7.2 Unless otherwise provided in the Contract Documents:

7.1.7.2.1 Allowances shall cover the cost to the Contractor of materials and equipment delivered at the Work site and all required taxes, less applicable trade discounts;

7.1.7.2.2 Allowances shall cover the Contractor's costs of unloading and handling at the Work site, labor, installation costs and other expenses contemplated for allowance items of the Work, including the Contractor's overhead and profit.

7.1.7.2.3 Whenever costs are more than or less than allowances, the Contract Price for the Work shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 7.1.7.2.1 and (2) changes in Contractor's costs under Section 7.1.7.2.2.

7.1.7.3 Materials and equipment under an allowance shall be selected by DFCM with reasonable promptness.

7.2 CONTRACTOR INITIATED REQUESTS.

7.2.1 THE REQUEST FOR INFORMATION ("RFI") PROCESS AND TIME TO FILE. Contractor may file an RFI with the A/E regarding any question the answer to which will assist Contractor in the proper completion of the Work, including, but not limited to, issues related to the Contract Documents, Drawings, and Specifications. The RFI shall be filed with the A/E in a timely manner so as not to prejudice DFCM as to the quality, time, or cost related to the Work.

7.2.2 PROPOSED CHANGE ORDER ("PCO"). Within seven (7) days after Contractor knows or should know of a situation or condition for which Contractor anticipates requesting an increase in the Contract Price and/or extension of the Contract Time, Contractor must file a Proposed Change Order ("PCO") with DFCM, or Contractor shall be deemed to waive any right to claim an increase in the Contract Price and/or extension of the Contract Time related to such situation or condition. The PCO shall include all documentation supporting the PCO available to Contractor at the time of filing and Contractor shall thereafter diligently pursue the supplementation(s) of such documentation and promptly deliver such supplementation(s) to DFCM.

7.2.2.1 One of the following may occur after a PCO is filed with DFCM:

7.2.2.1.1 DFCM, after considering any input by the A/E, may reach an agreement with Contractor and issue a Change Order.

7.2.2.1.2 DFCM, after considering any input by the A/E, may issue a Construction Change Directive.

7.2.2.1.3 If DFCM, after considering any input by the A/E, disagrees with Contractor's PCO, DFCM may seek additional information or verification from Contractor, the A/E, or other sources, and may negotiate with

Contractor, may issue a Change Order upon such later agreement, may issue or retract an issued PR, or may issue a Construction Change Directive.

7.2.2.2 If a Construction Change Directive is issued which identifies DFCM's position in regard to a Contract Price and/or Contract Time adjustment or if a PCO is denied by DFCM, Contractor must file a PRE no later than twenty-one (21) days after Contractor's receipt of the Construction Change Directive or such denial of the PCO. Failure to timely file a PRE shall be deemed to waive any right to an increase in the Contract Price and/or extension of the Contract Time related to a Construction Change Directive beyond that identified by DFCM in the Construction Change Directive, if any, or denial of the PCO. Such waiver shall entitle DFCM to convert a Construction Change Directive into a Change Order, whether or not executed by Contractor.

7.2.2.3 If a Construction Change Directive leaves open the determination of an increase in the Contract Price and/or extension of the Contract Time related to a change in the Work, then the time period for commencement of filing the PRE shall not accrue until such time as DFCM has conveyed to Contractor DFCM's position as to increase, if any, in the Contract Price and/or extension, if any, of the Contract Time as a result of the change in the Work.

7.2.2.4 The Contractor must continually cooperate with DFCM in providing data, documentation and efforts to resolve any issues related to a PCO.

7.2.3 **SUBSTITUTIONS.** The Contractor may make substitutions only with the consent of DFCM, after evaluation by the A/E and in accordance with a Change Order. Substitutions will be considered after the award of the Contractor's Agreement only when a PCO is submitted by the Contractor to substitute a non-specified product for a product specified in the Contract Documents, under the following conditions:

7.2.3.1 The PCO is accompanied by complete data on the proposed substitution substantiating compliance with the design intent and performance requirements of the Contract Documents, including product identification and description, performance and test data, references and samples where applicable, comparison of the proposed substitution with the products specified or named in the Contract Documents, and the impact of the substitution upon the Contract Time.

7.2.3.2. The PCO is accompanied by accurate cost data on the proposed substitution and comparison with the products specified, whether or not modification of the Contract Price is to be a consideration.

7.2.3.3 The Contractor is responsible for any additional costs for the A/E's additional services caused by the evaluation of the proposed substitution and/or the substitution of products.

7.2.3.4 The PCO for substitution by the Contractor shall constitute a certification by the Contractor that the Contractor has investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified; the cost data presented by the Contractor is complete and includes all related costs under the Contract Documents, including the A/E's additional services; the Contractor waives all claims for additional costs related to the substitution which subsequently become apparent; the Contractor will provide the same guarantee or warranty for the substituted product that the Contractor would have provided for the product specified in the Contract Documents; and the Contractor will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be properly completed in all respects.

7.2.3.5 Substitutions will not be considered by the A/E or DFCM if they are intended or implied by submittals of Shop Drawings, Product Data or Samples without a PCO for substitution or when for their implementation they require a substantial revision of the Contract Documents in order to accommodate their use.

7.3 PROPOSAL REQUEST INITIATED BY DFCM. DFCM may submit a Proposal Request to Contractor seeking information, data, impact on the Contract Price and/or impact on the Contract Time for a change in the Work or other modification to the Contract Documents. The PR shall provide a time limit for Contractor to file a response with the A/E and DFCM. If a proposal is not timely provided by Contractor, DFCM may calculate a Change Order under Section 7.4.2. Upon timely receipt of a proposal, one of the following shall occur:

7.3.1 IF AGREEMENT, CHANGE ORDER ISSUED. DFCM, after considering any input by the A/E, may reach an agreement with the Contractor and issue a Change Order.

7.3.2 IF DISAGREEMENT. If DFCM disagrees with Contractor's proposal, after considering any input from the A/E, DFCM may seek additional information or verification from Contractor or other sources, may negotiate with Contractor, may issue a Change Order upon such later agreement, may retract the PR, or may issue a Construction Change Directive. If a Construction Change Directive is issued that identifies DFCM's position in regard to the increase, if any in the Contract Price and/or extension, if any, of the Contract Time, Contractor must file a PRE within twenty-one (21) days of Contractor's receipt of the Construction Change Directive, or Contractor shall be deemed to waive any right for an increase in the Contract Price and/or extension of the Contract Time as a result of the issuance of the Construction Change Directive beyond that identified by DFCM in the Construction Change Directive, if any. Such waiver shall entitle DFCM to convert the Construction Change Directive into a Change Order, whether or not executed by Contractor. If the Construction Change Directive leaves open the determination of an increase, if any, in the Contract Price and/or extension, if any, of the Contract Time related to the change in the Work, then the time period for commencement of filing the PRE shall not accrue until such time as DFCM has conveyed to Contractor DFCM's position as to the increase, if any, in the Contract Price and/or extension, if any, of the Contract Time resulting from the change in the Work.

7.4 CHANGE ORDERS.

7.4.1 ADJUSTING PRICE BASED UPON AGREEMENT. If a Change Order provides for an adjustment to the Contract Price, the adjustment shall be based on the mutual agreement of Contractor and DFCM, including any terms mandated by unit price agreements or other terms of the Contract Documents.

7.4.2 DFCM RESOLUTION OF PRICE IN THE ABSENCE OF AN AGREEMENT UNDER SECTION 7.4.1. In the absence of an agreement under Section 7.4.1, the adjustment in Contract Price shall be based on an itemized accounting of costs and savings supported by appropriate data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section shall be limited to the following:

7.4.2.1 All direct and indirect costs of labor; including workers' compensation insurance, social security, and other federal and state payroll-based taxes, and payroll-based fringe benefits paid by Contractor so long as they are reasonable and no higher than that charged to other clients;

7.4.2.2 Costs of materials, on-site temporary facilities, supplies, and equipment (except hand tools) required for or incorporated into the Work;

7.4.2.3 Rental costs of machinery, equipment, tools (except hand tools), and on-site temporary facilities, whether rented from Contractor or others;

7.4.2.4 Costs of permits and other fees, sales, use or similar taxes related to the Work; and

7.4.2.5 Overhead and profit. The markups stated herein for overhead and profit are intended to cover the Contractor's profit and all indirect costs associated with a change in the Work. Items covered by such markups include, but are not limited to: home office expenses, branch office and field office overhead expense of any

kind; project management; estimating, engineering; coordinating; expediting; purchasing; billing and invoicing; detailing; legal, accounting, data processing or other administrative expenses; computer and telephone costs (including computer and phone allowances); shop drawings; liability insurance premium, auto insurance premium, performance and payment bond premium and SDI; vehicle costs (including vehicle allowances); ESOP related costs; and warranty expense costs. The cost for the use of small tools is also to be considered covered by such markups. Small tools shall be defined as tools and equipment (power or non-power) with an individual purchase cost of less than Seven Hundred Fifty Dollars (\$750).

7.4.2.5.1 The maximum markup percentage to be paid to any contractor (regardless of tier) including Contractor, a Subcontractor and/or Sub-subcontractor on self-performed work shall be a single markup percentage not-to-exceed fifteen percent (15%) of the net increased direct cost of: (A) direct labor and allowable labor burden costs applicable to the change in the Work; (B) the net cost of material and installed equipment incorporated into the change in the Work, and (C) net rental cost of major equipment and related fuel costs necessary to complete the change in the Work;

7.4.2.5.2 With respect to pricing the portion of Change Orders involving work performed by lower tier contractors, including Subcontractors and Sub-subcontractors, the maximum markup percentage allowable to the Contractor, Subcontractor or Sub-subcontractor supervising the lower tier contractor's work shall not exceed seven percent (7%) of the net increase of all approved changes in the Work performed by all contractors combined for any particular Change Order.

7.4.2.5.3 Contractor agrees to include these limitations on Change Order pricing in Contractor's subcontracts with Subcontractors and shall likewise require all of Contractor's Subcontractors to include the same provisions in all sub-subcontracts with their respective Sub-subcontractors of any tier.

7.4.3 CREDITS. The amount of credit to be allowed by Contractor to DFCM for a deletion or change in the Work which results in a net decrease in the Contract Price shall be actual net cost as confirmed to DFCM based upon corroboration by an appropriate source, provided, however, the application of the markup percentages referenced in Section 7.4.2.5 for overhead and profit will apply only to additive change orders. In those instances where a change in the Work involves both additive and deductive work, the additions and deductions will be netted and the markup percentage adjustments will be applied to the net additive amount, if any.

7.4.4 EFFECT OF A CHANGE ORDER. A Change Order signed by the Contractor constitutes the Contractor's agreement that, when implemented by DFCM, the adjustment in the Contract Price, if any, and/or the adjustment in the Contract Time, if any, for the change in the Work shall fully and finally compensate the Contractor and its Subcontractors and Sub-subcontractors of any tier for any and all additional costs, damages or expenses arising directly or indirectly out of the change in the Work described in the Change Order.

7.4.4.1 All Change Orders shall be conclusively presumed to constitute settlement of all Claims for direct or indirect damages of the Contractor, its Subcontractors and their respective Sub-subcontractors of any tier arising out of the change in the Work. This shall include, but is not limited to, any and all so-called "delay," "equitable adjustment," "impact," "cumulative impact," "acceleration," "constructive acceleration," "inefficiency," "interference," "indirect," "ripple" or "consequential" claims, costs or damages and all direct or indirect costs pertaining to the Contractor's home office, branch offices, or field site office and all other costs and effects whatsoever relating to the change in the Work.

7.4.4.2 Any statement unilaterally added by the Contractor to a Change Order or contained in any transmittal or separate correspondence wherein the Contractor unilaterally attempts to reserve rights to seek any further increases in the Contract Price and/or further extensions of the Contract Time for a change in the Work that is the subject of the Change Order and/or arising out of, related to and/or connected with the change in the Work described in the Change Order shall be null and void.

7.5 CONSTRUCTION CHANGE DIRECTIVES.

7.5.1 WHEN USED AND CONTRACTOR'S RIGHT TO CHALLENGE. Without invalidating the Contractor's Agreement, DFCM reserves the right to unilaterally issue, in DFCM's sole discretion, a Construction Change Directive that requires Contractor to proceed with a change in the Work. DFCM may order minor changes within the scope of Work without granting an adjustment in the Contract Price or an extension of the Contract Time if such minor changes within the scope of Work are consistent with the intent of the Contract Documents. In order to expedite the Work and avoid or minimize delays in the Work that may affect the Contract Price or Contract Time, the Contract Documents shall be amended as described below. If the Construction Change Directive leaves open the determination of an increase, if any, in the Contract Price and/or extension, if any, of the Contract Time related to the change in the Work, then the Construction Change Directive shall indicate the timeframe(s) in which Contractor shall provide further information to resolve such open issue(s). When DFCM and Contractor agree upon an increase, if any, in the Contract Price and/or extension, if any, in the Contract Time related to a Construction Change Directive, the parties shall execute a Change Order. Additionally, the Construction Change Directive may be converted to a Change Order under Section 7.2.2.2 or Section 7.3.2.

7.5.2 PROCEED WITH WORK. Upon receipt of a Construction Change Directive, Contractor shall promptly proceed with the change in the Work involved.

7.5.3 INTERIM PAYMENTS BY DFCM. Pending the final determination of the increase in the Contract Price, if any, associated with a Construction Change Directive, DFCM shall pay any undisputed amount to Contractor.

7.6 ASI. The A/E may at any time that is consistent with maintaining the quality, safety, time, budget, and function of the Work, issue to Contractor an ASI after approval from DFCM is obtained.

7.7 PROCEDURE FOR PRELIMINARY RESOLUTION EFFORTS.

7.7.1 REQUEST FOR PRELIMINARY RESOLUTION EFFORT (PRE). If Contractor wishes to raise an issue related to an alleged breach of contract by DFCM or an issue concerning time or money, Contractor shall file a PRE as a prerequisite for any consideration of the issue by DFCM. The labeling of the notice or request shall not preclude the consideration of the issue by DFCM.

7.7.2 TIME FOR FILING. The PRE must be filed in writing with DFCM within twenty-one (21) days of any of the following:

7.7.2.1 Issuance of a Construction Change Directive that states the adjustment in Contract Price and/or Contract Time, if any, if Contractor disagrees with such adjustment;

7.7.2.2 Issuance of a statement of DFCM's position with respect to the adjustment in Contract Price and/or Contract Time, if any, in a previously issued Construction Change Directive that left open the adjustment in Contract Price and/or Contract Time, if Contractor disagrees with such statement;

7.7.2.3 Issuance of a denial of a PCO by DFCM;

7.7.2.4 In the case of a Subcontractor, after the expiration of the time period for the Contractor/Subcontractor PRE process under Section 7.7.5; or

7.7.2.5 Except as provided in Section 7.2.2, when Contractor knows or should have known about any other issue where Contractor seeks an adjustment in the Contract Price, Contract Time and/or other relief from DFCM.

7.7.3 CONTENT REQUIREMENT. The PRE shall be required to include in writing to the extent information is reasonably available at the time of filing of the PRE:

7.7.3.1 A description of the issue;

7.7.3.2 The potential impact on the Work, Contract Price and/or Contract Time; and

7.7.3.3 An indication of the relief sought.

7.7.4 SUPPLEMENTATION. Additional detail of the content requirement under Section 7.7.3 shall be provided later if the detail is not yet available at the initial filing as follows:

7.7.4.1 While the issue is continuing or the impact is being determined, Contractor shall provide a written updated status report every thirty (30) days or as otherwise reasonably requested by DFCM; and

7.7.4.2 After the issue is concluded and/or the impact is determinable, complete information, including any impacts on Contract Price, Contract Time and/or other relief requested, if any, must be provided to DFCM within twenty-one (21) days of the earlier of the date the issue is concluded or the impact is determinable.

7.7.5 SUBCONTRACTORS. Contractor must include the provisions of this Section 7.7.5 in Contractor's subcontract with each Subcontractor and require each Subcontractor to do likewise in each Subcontractor's sub-subcontracts with Sub-subcontractors. At Contractor's discretion, Contractor may allow a Sub-subcontractor at the second tier and beyond to submit a PRE directly to Contractor.

7.7.5.1 In order for a Subcontractor at any tier to be involved with the PRE of DFCM, the following conditions and process shall apply:

7.7.5.1.1 The Subcontractor must have attempted to resolve the issue with Contractor, including the submission of a PRE with Contractor.

7.7.5.1.2 The Subcontractor must file a copy of the PRE with DFCM;

7.7.5.1.3 The PRE to Contractor must meet the time, content, and supplementation requirements of Sections 7.7.2, 7.7.3 and 7.7.4. The triggering event for a Subcontractor to file a PRE shall be the time at which the issue cannot be resolved through negotiation;

7.7.5.1.4 The PRE submitted to Contractor shall only be eligible for consideration in DFCM's PRE process to the extent the issue is reasonably related to the performance of DFCM or an entity for which DFCM is liable;

7.7.5.1.5 Contractor shall resolve the PRE with the Subcontractor within sixty (60) days of its submittal to Contractor or such other time period as subsequently agreed to by the Subcontractor in writing. If Contractor fails to resolve the PRE with the Subcontractor within such required time period, the Subcontractor may submit in writing the PRE with Contractor and DFCM. In order to be eligible for DFCM's consideration of the PRE, the Subcontractor must submit the PRE within twenty-one (21) days of the expiration of the time period for the Contractor/Subcontractor PRE process. DFCM shall consider the PRE as being submitted by Contractor on behalf of the Subcontractor;

7.7.5.1.6 Upon such PRE being submitted, Contractor shall cooperate with DFCM in reviewing the issue;

7.7.5.1.7 DFCM shall not be obligated to consider any submission which is not in accordance with any provision of this Section 7.7.5;

7.7.5.1.8 The Subcontractor may accompany Contractor in participating with DFCM regarding the PRE raised by the Subcontractor. DFCM shall not be precluded from meeting with Contractor separately, and it shall be the responsibility of Contractor to keep the Subcontractor informed of any such meetings; and

7.7.5.1.9 Notwithstanding any provision of this Section 7.7.5, a Subcontractor shall be entitled to pursue a payment bond claim.

7.7.6 INFORMATION AND MEETINGS. DFCM may request additional information and may meet with the parties involved with the issue.

7.7.7 CONTRACTOR REQUIRED TO CONTINUE PERFORMANCE. Pending the final resolution of the issue, unless otherwise agreed upon in writing by DFCM, Contractor shall proceed diligently with performance of the Work and DFCM shall continue to make payments of undisputed amounts in accordance with the Contract Documents.

7.7.8 DECISION. DFCM shall issue to Contractor, and any other third party brought into the process by DFCM as being potentially liable to DFCM, a written decision providing the basis for the decision on the issues presented by all of the parties within thirty (30) days of receipt of all the information required under Sections 7.7.3 and 7.7.4.

7.7.9 DECISION FINAL UNLESS CLAIM SUBMITTED. The decision by DFCM shall be final, and not subject to any further administrative or judicial review (not including judicial enforcement) unless a Claim is submitted in accordance with these General Conditions.

7.7.10 EXTENSION REQUIRES MUTUAL AGREEMENT. Any time period specified in Section 7.7 may be extended by mutual agreement of Contractor and DFCM.

7.7.11 IF DECISION NOT ISSUED. If the decision is not issued within the thirty (30) day period, stated in Section 7.7.8 including any agreed to extensions, the issue may be pursued as a Claim.

7.7.12 PAYMENT FOR PERFORMANCE.

7.7.12.1 Except as otherwise provided in the Contract Documents, any final decision where DFCM is to pay additional monies to Contractor, shall not be delayed by any PRE, Claim, or appeal by another party.

7.7.12.2 Payment to Contractor in accordance with any final decision shall be made by DFCM consistent with the Contract Documents.

7.7.12.3 Notwithstanding any other provision of the Contract Documents, payment to Contractor shall be subject to any set-off, claims, or counterclaims of DFCM.

7.7.12.4 Payment to Contractor for a Subcontractor issue submitted by the Contractor shall be paid by Contractor to Subcontractor in accordance with the subcontract between Contractor and Subcontractor.

7.7.12.5 Any payment or performance determined owing by Contractor to DFCM shall be made in accordance with the Contract Documents.

7.8. RESOLUTION OF CLAIM.

7.8.1 CLAIM. If the decision on the PRE is not issued within the required timeframe or if Contractor is not satisfied with the decision, Contractor, or other party brought into the process by DFCM, may submit a Claim in accordance with this Section 7.8 as a prerequisite for any further consideration by DFCM or the right to any judicial review of the issue giving rise to the Claim.

7.8.2 SUBCONTRACTORS. In order for a Subcontractor to have its issue considered in the Claim process by DFCM, the Subcontractor that had its issue considered under Section 7.7.5 may submit the issue as a Claim by filing it with Contractor and DFCM within the same timeframe and with the same content requirements as required of a Claim submitted by Contractor under this Section 7.8.2. DFCM shall consider the Claim as being submitted by Contractor on behalf of the Subcontractor. Under no circumstances shall any provision of these General Conditions or the Contract Documents be construed so as to create any contractual relationship between DFCM and any Subcontractor.

7.8.2.1 Upon such Claim being submitted, the Contractor shall fully cooperate with the Director, the person(s) evaluating the claim and any subsequent reviewing authority.

7.8.2.2 The Director shall not be obligated to consider any submission which is not in accordance with this Section 7.8.2.

7.8.2.3 The Subcontractor may accompany Contractor in participating with the Director, the person(s) evaluating the Claim and any subsequent reviewing authority regarding the Claim. The Director, the person(s) evaluating the Claim, and any subsequent reviewing authority is not precluded from meeting with Contractor separately, and it shall be the responsibility of Contractor to keep the Subcontractor informed of any such meetings and matters discussed.

7.8.2.4 Notwithstanding any provision of this Section 7.8, a Subcontractor shall be entitled to pursue a payment bond claim.

7.8.3 TIME FOR FILING. The Claim must be filed in writing promptly with the Director of DFCM, but in no case more than twenty-one (21) days after the decision is issued on the PRE under Section 7.7.8 or no more than twenty-one (21) days after the thirty (30) day period under Section 7.7.11 has expired with a decision not issued.

7.8.4 CONTENT REQUIREMENT. The written Claim shall include:

7.8.4.1 A description of the issues in dispute;

7.8.4.2 The basis for the Claim, including documentation and analysis required by the Contract Documents and applicable law and rules that allow for the proper determination of the Claim;

7.8.4.3 A detailed cost estimate for any amount sought, including copies of any related invoices; and

7.8.4.4 A specific identification of the relief sought.

7.8.5 EXTENSION OF TIME TO SUBMIT DOCUMENTATION. The time period for submitting documentation and any analysis to support a Claim may be extended by the Director upon written request of the claimant showing just cause for such extension, which request must be included in the initial Claim submittal.

7.8.6 CONTRACTOR REQUIRED TO CONTINUE PERFORMANCE. Pending the final determination of the Claim, including any judicial review or appeal process, and unless otherwise agreed upon in writing by the Director, Contractor shall proceed diligently with performance of the Contract and DFCM shall continue to make payments of undisputed amounts in accordance with the Contract Documents.

7.8.7 AGREEMENT OF CLAIMANT ON METHOD AND PERSON(S) EVALUATING THE CLAIM. The Director shall first attempt to reach agreement with the claimant on the method and person(s) to evaluate the Claim. If such agreement cannot be made within fourteen (14) days of filing of the Claim, the Director shall select the method and person(s), considering the purposes described in Rule R23-26-1. Unless agreed to by the Director and the claimant, any selected person shall not have a conflict of interest or appearance of impropriety. Any party and the person(s) evaluating the Claim has a duty to promptly raise any circumstances regarding a conflict of interest or appearance of impropriety. If such a reasonable objection is raised, and unless otherwise agreed to by the Director and the claimant, the Director shall take appropriate action to eliminate the conflict of interest or appearance of impropriety. The dispute resolution methods and person(s) may include any of the following:

7.8.7.1 A single expert and/or hearing officer qualified in the field that is the subject of the Claim;

7.8.7.2 An expert panel, consisting of members that are qualified in a field that is the subject of the Claim;

7.8.7.3 An arbitration process which may be binding if agreed to by the parties to the Claim;

7.8.7.4 A mediator; or

7.8.7.5 Any other method that best accomplishes the purposes set forth in Rule R23-26-1.

7.8.8 THE EVALUATION PROCESS, TIMEFRAMES OF EVALUATOR(S), DIRECTOR'S DETERMINATION, ADMINISTRATIVE APPEAL TO THE EXECUTIVE DIRECTOR AND JUDICIAL REVIEW. The Claim shall be evaluated, the timeframe for specific events related to the person(s) evaluating the Claim, the Director's determination, any appeal to the Executive Director and any judicial review shall be subject to the provisions of Rule R23-26-5(8), R23-26-5(9), R23-26-6 and R23-26-8. A copy of these Administrative Rules is available at <https://rules.utah.gov>.

7.8.9 APPEAL PROCESS PREREQUISITE FOR FURTHER CONSIDERATION OR JUDICIAL REVIEW. The administrative appeal to the Executive Director is a prerequisite for any further consideration by the State of Utah, or to judicial review of the issue giving rise to the Claim. It shall be

considered that the Contractor, or another party brought into the process by DFCM, has not exhausted its administrative remedies if such an administrative appeal is not undertaken.

7.8.10 PAYMENT OF CLAIM.

7.8.10.1 When a stand-alone component of a Claim has received a final determination, and is no longer subject to review or appeal, that amount shall be paid in accordance with the payment provisions of the Contract Documents or judicial order.

7.8.10.2 When the entire Claim has received a final determination, and is no longer subject to review or appeal, the full amount shall be paid within fourteen (14) days of the date of the final determination unless the Work or services have not been completed, in which case the amount shall be paid in accordance with the payment provisions of the Contract Documents to the point that the Work is completed.

7.8.10.3 The final determination date is the earlier of the date upon which the claimant accepted the settlement in writing with an executed customary release document and waived its rights of appeal, or the expiration of the appeal period, with no appeal filed, or the determination made resulting from the final appeal.

7.8.10.4 Any final determination where DFCM is to pay additional monies to Contractor shall not be delayed by any appeal or request for judicial review by another party brought into the process by DFCM as being liable to DFCM.

7.8.10.5 Notwithstanding any other provision of the Contract Documents, payment of all or part of a Claim shall be subject to any set-off, claims, or counterclaims of DFCM.

7.8.10.6 Payment to Contractor for a Subcontractor issue (Claim) deemed filed by Contractor, shall be paid by Contractor to the Subcontractor in accordance with the subcontract between Contractor and the Subcontractor.

7.8.10.7 The execution of a customary release document by the claimant related to any payment may be required as a condition of making the payment. Unless expressly and specifically released in writing by DFCM, settlement of a Claim by DFCM shall not be deemed a waiver of Claims reserved under Section 8.8.3.

7.8.11 ALLOCATION OF COSTS OF CLAIM RESOLUTION PROCESS.

7.8.11.1 In order to file a Claim, a claimant must pay a Fifteen Hundred Dollar (\$1,500.00.00) filing fee to DFCM. When the Claim is a pass-through from a Subcontractor in accordance with Section 7.7.5, the payment of the fee shall be made by the Subcontractor.

7.8.11.2 Unless otherwise agreed to by the parties to the Claim, the costs of resolving the Claim shall be allocated among the parties on the same proportionate basis as the determination of financial responsibility for the Claim.

7.8.11.3 The costs of resolving the Claim that are subject to allocation include the claimant's filing fee, the costs of any person(s) evaluating the Claim, the costs of making any required record of the process, and any additional testing or inspection procured to investigate and/or evaluate the Claim.

7.8.11.4 Each party shall be responsible for its own attorney fees.

7.8.12 ALTERNATIVE PROCEDURES. To the extent otherwise permitted by law, if all parties to a Claim agree in writing, a protocol for resolving a Claim may be used that differs from the process described in this Section 7.8.

7.8.13 IMPACT ON FUTURE SELECTIONS.

7.8.13.1 The presentation of a good faith and non-frivolous issue or Claim shall not be considered by DFCM in DFCM’s selection process for a future award of contract; and

7.8.13.2 The submission of a bad faith and frivolous issue or Claim, or the failure by a Contractor to facilitate resolution of a Claim, may be considered in DFCM’s evaluation of performance.

7.8.14* DFCM’S RIGHT TO HAVE ISSUES, DISPUTES OR CLAIMS CONSIDERED. As stated in Rule R23-26-1(6), Sections 7.7 and 7.8 do not limit the right of DFCM to have any of DFCM’s issues, disputes or claims considered. DFCM reserves all rights to pursue DFCM’s issues, disputes or claims in law or equity including, but not limited to, any or all of the following: damages, delay damages and impacts, losses, liability, patent or latent defects, or failure to perform under the Contract Documents. If the Director appoints an expert or a panel to consider any such issue(s), dispute(s) or claim(s) of DFCM, Contractor shall cooperate with such expert or panel process.

**The previous ‘Section 7.8.14 REPORT TO THE BUILDING BOARD’ has been removed as of 07122023.
The previous ‘Section 7.8.15 DFCM’S RIGHT TO HAVE ISSUES, DISPUTES OR CLAIMS CONSIDERED’ has been renumbered to Section 7.8.14 as of 07122023.

ARTICLE 8. PAYMENTS AND COMPLETION.

8.1 SCHEDULE OF VALUES. With the first Application for Payment, Contractor shall submit to the A/E and DFCM a schedule of values allocated to all the various portions of the Work. The schedule of values shall be submitted on the form approved and provided by DFCM. The schedule of values must consist of a detailed and specific breakdown of values actually associated with the various items of Work and shall in no event be “frontloaded”. The A/E shall make recommendations to DFCM regarding the schedule of values including any suggested modifications. When approved, including any approved modifications, by DFCM, it shall be the basis for future Contractor Applications for Payment. Contractor shall be entitled to reasonably reallocate values in the schedule of values with prior written notice to DFCM. Contractor shall not be entitled to payment until receipt and acceptance of the schedule of values.

8.2 APPLICATIONS FOR PAYMENT.

8.2.1 IN GENERAL. The following general requirements shall be met:

8.2.1.1 Contractor shall submit to the A/E an itemized Application for Payment for Work completed in accordance with the schedule of values and that reflects retainage as provided for in the Contractor’s Agreement. The Application for Payment shall be on a form approved and provided by DFCM.

8.2.1.2 The Application for Payment shall be supported by such data substantiating Contractor’s right to payment as DFCM or the A/E may require.

8.2.1.3 The Application for Payment may include requests for payment pursuant to approved Change Orders or Construction Change Directives.

8.2.1.4 The Application for Payment shall not include requests for payment for portions of the Work performed by a Subcontractor when Contractor does not intend to pay that Subcontractor because of a dispute or other reason.

8.2.1.5 In executing the Application for Payment, Contractor shall attest that Subcontractors involved with prior Applications for Payment have been paid, unless Contractor provides a detailed explanation why such

payment has not occurred. DFCM reserves the right to require Contractor to submit a Utah Conditional Waiver and Release Upon Progress Payment form from one or more Subcontractors.

8.2.2 PAYMENT FOR MATERIAL AND EQUIPMENT. Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the Work site for subsequent incorporation into the Work. If approved in advance by DFCM and A/E, payment may similarly be made for materials and equipment suitably stored off-site at a location agreed upon in writing. Payment for materials and equipment stored on or off-site shall be conditioned upon compliance by Contractor with procedures satisfactory to DFCM to establish DFCM's title to such materials and equipment or otherwise protect DFCM's interest, and shall include applicable insurance, storage, and transportation to the Work site for such materials and equipment stored off-site. DFCM may require copies of invoices or other suitable documentation.

8.2.3 WARRANTY OF TITLE. Contractor warrants that title to all Work covered by an Application for Payment shall pass to DFCM no later than the time for payment. Contractor further warrants that upon submittal of an Application for Payment, all Work for which Certificates for Payment have been previously issued and payments received from DFCM shall, to the best of Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances in favor of the Contractor, Subcontractors, or other persons or entities making a claim by reason of having provided labor, materials, and/or equipment relating to the Work.

8.2.4 HOLDBACK BY DFCM. Notwithstanding anything to the contrary contained in the Contract Documents, DFCM may, as a result of the claims resolution process, withhold any payment to Contractor if and for so long as Contractor fails to perform any of its obligations under the Contract Documents or otherwise is in default under any of the Contract Documents.

8.3 CERTIFICATES FOR PAYMENT.

8.3.1 ISSUED BY A/E. The A/E shall within seven (7) days after receipt of Contractor's Application for Payment, either issue to DFCM a Certificate for Payment, with a copy to the Contractor, for such amount as the A/E determines due or notify Contractor and DFCM in writing of the A/E's reasons for withholding certification in whole or in part as provided in Section 8.4.1. If the A/E fails to act within said seven (7) day period, Contractor may file the Application for Payment directly with DFCM and DFCM shall thereafter have twenty-one (21) days from the date of DFCM's receipt to resolve the amount to be paid and to pay the undisputed amount. The accuracy of Contractor's Applications for Payment shall be Contractor's responsibility, not A/E's.

8.3.2 A/E'S REPRESENTATIONS. The A/E's issuance of a Certificate for Payment shall constitute a representation to DFCM that to the best of the A/E's knowledge, information and belief, based upon the A/E's observations at the site, the data comprising the Application for Payment, and what is reasonably inferable from the observations and data, that the Work has progressed to the point indicated in the Application for Payment and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to minor deviations from the Contract Documents correctable prior to completion and to specific qualifications expressed by the A/E. The issuance of a Certificate for Payment shall further constitute a representation that Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment shall not be a representation that the A/E has: (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences or procedures; (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by DFCM to substantiate Contractor's right to payment; (4) ascertained how or for what purpose Contractor used money previously paid on account of Contract Price; or (5) any duty to make such inquiries.

8.4 DECISIONS TO WITHHOLD CERTIFICATION.

8.4.1 WHEN WITHHELD. The A/E may decide not to certify payment and may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect DFCM, if in the A/E's judgment the representations to DFCM required in Section 8.3.2 cannot be made. If the A/E is unable to certify payment in the amount of the Application for Payment, the A/E shall notify Contractor and DFCM as provided in Section 8.3.1. If Contractor and the A/E cannot agree on a revised amount, the A/E shall promptly issue a Certificate for Payment for the amount to which the A/E makes such representations to DFCM. The A/E may also decide not to certify payment or, because of subsequently discovered evidence or observations, may nullify the whole or part of a Certificate for Payment previously issued, to such extent as may be necessary in the A/E's opinion to protect DFCM from loss because of:

8.4.1.1 Defective Work not remedied;

8.4.1.2 Third party claims filed or reasonable evidence indicating probable filing of such claims;

8.4.1.3 Failure of Contractor to make payments properly to Subcontractors or for labor, materials, or equipment;

8.4.1.4 Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Price;

8.4.1.5 Damage to DFCM or another contractor;

8.4.1.6 Reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance of the Contract Price would not be adequate to cover actual or liquidated damages for the anticipated delay; or

8.4.1.7 Failure to carry out the Work in accordance with the Contract Documents.

8.4.2 CERTIFICATION ISSUED WHEN REASONS FOR WITHHOLDING REMOVED. When the reasons stated in Section 8.4.1 for withholding certification are removed, certification shall be made for such related amounts.

8.4.3 CONTINUE WORK EVEN IF CONTRACTOR DISPUTES A/E'S DETERMINATION. If Contractor disputes any determination by the A/E or the result of the claims resolution process with regard to any Certification of Payment, Contractor nevertheless shall expeditiously continue to prosecute the Work.

8.4.4 DFCM NOT IN BREACH. DFCM shall not be deemed to be in breach of Contractor's Agreement by reason of the withholding of any payment pursuant to any provision of the Contract Documents provided DFCM's action or such withholding is consistent with the results of the dispute resolution process.

8.5 PROGRESS PAYMENTS.

8.5.1 IN GENERAL, INTEREST OR LATE PAYMENTS.

8.5.1.1 Except as provided in Section 8.3.1, DFCM shall pay any undisputed amount within twenty-eight (28) days of the date that the Application for Payment was submitted to the A/E. In no event shall DFCM be required to pay any disputed amount.

8.5.1.2 Except as otherwise provided by law, if any payment is late based upon the provisions of the Contract Documents, Contractor shall be paid interest at the rate stated in Utah Code § 15-6-3.

8.5.2 CONTRACTOR AND SUBCONTRACTOR RESPONSIBILITY. Contractor shall promptly and no later than the date established in Utah Code § 15-6-5 pay each Subcontractor, upon receipt of payment from DFCM, out of the amount paid to Contractor on account of such Subcontractor's portion of the Work, the amount to which said Subcontractor is entitled. Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payment to its Sub-subcontractors in a similar manner.

8.5.3 INFORMATION FURNISHED BY A/E OR DFCM TO SUBCONTRACTOR. The A/E or DFCM shall, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by Contractor and action taken thereon by the A/E and DFCM on account of portions of the Work done by such Subcontractor.

8.5.4 DFCM AND A/E NOT LIABLE. Neither DFCM or A/E shall have an obligation to pay, monitor, or enforce the payment of money to a Subcontractor, except to the extent as may otherwise be required by law.

8.5.5 CERTIFICATE, PAYMENT OR USE NOT ACCEPTANCE OF DEFECTIVE WORK. A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Work by DFCM shall not constitute acceptance of Work that is not in accordance with the Contract Documents.

8.6 PAYMENT UPON SUBSTANTIAL COMPLETION. Upon Substantial Completion of the Work or designated portion thereof and upon application by Contractor and certification by the A/E, DFCM shall make payment, reflecting adjustment in retainage, if any, for such Work or portion thereof as provided in the Contract Documents. To the extent allowed by law, DFCM may retain until final completion up to twice the fair market value of the Work that has not been completed in accordance with the Contract Documents, or, in the absence of applicable Contract Documents, generally accepted craft standards.

8.7 PARTIAL OCCUPANCY OR USE.

8.7.1 IN GENERAL. DFCM may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with Contractor and authorized by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is Substantially Complete, provided DFCM and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of the warranties required by the Contract Documents. When Contractor considers a portion to be Substantially Complete, Contractor shall prepare and submit a list to the A/E as previously provided for herein. Consent of Contractor to partial occupancy or use shall not be unreasonably withheld. Contractor shall have continuing responsibility to protect the Work site and the Work during such partial occupancy or use and shall be responsible for damage except to the extent caused solely by DFCM during such partial occupancy or use. The stage of progress of the Work shall be determined by written agreement between DFCM and Contractor.

8.7.2 INSPECTION. Immediately prior to such partial occupancy or use, DFCM, Contractor and A/E shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

8.7.3 NOT CONSTITUTE ACCEPTANCE. Except to the extent it is agreed upon in writing by DFCM, partial occupancy or use of a portion of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

8.7.4 INSURANCE. Partial occupancy or use shall not commence until the insurance company or companies providing property insurance under Section 10.2 have provided any required consent to such partial

occupancy or use by endorsement or otherwise. DFCM shall take reasonable steps to obtain any required consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

8.8 FINAL PAYMENT.

8.8.1 CERTIFICATE FOR PAYMENT. The A/E's final Certificate for Payment shall constitute a further representation that the conditions listed in Section 8.8.2 as precedent to Contractor's being entitled to final payment have been fulfilled.

8.8.2 CONDITIONS FOR FINAL PAYMENT. Neither final payment nor any remaining retained percentage shall become due until Contractor submits to the A/E the following to the extent required by DFCM:

8.8.2.1 An affidavit that payrolls, bills for material and equipment, and other indebtedness connected with the Work (less amounts withheld by DFCM) have been paid or otherwise satisfied;

8.8.2.2 A current or additional certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and shall not be canceled or allowed to expire until at least twenty-eight (28) days prior written notice, by certified mail, return receipt requested, has been given to DFCM;

8.8.2.3 A written statement that Contractor knows of no reason that the insurance shall not be renewable to cover the period required by the Contract Documents;

8.8.2.4 If requested by the surety in a timely manner or by DFCM, consent of surety, to final payment;

8.8.2.5 Receipt of Record Drawings, Specifications, Addenda, Change Orders and other Modifications maintained at the site; the warranties, instructions, operation and maintenance manuals, and training videos required to be furnished by the Contract Documents;

8.8.2.6 Other data establishing payment or satisfaction of obligations, such as a Utah Waiver and Release Upon Final Payment form from Contractor, Subcontractors and Sub-subcontractors, receipts, other releases and waivers of liens, claims, security interests, or encumbrances arising out of Contractor's Agreement, to the extent and in such form as may be designated by DFCM. If a Subcontractor or Sub-subcontractor refuses to furnish a release or waiver required by DFCM, DFCM may require consent of surety to the final payment. If liens, claims, security interests, or encumbrances remain unsatisfied after payments are made, Contractor shall refund to DFCM all money that DFCM may be compelled to pay in discharging such liens, claims, security interests or encumbrances including all costs and reasonable attorney fees; and

8.8.2.7 A written statement demonstrating how Contractor shall distribute interest earned on retention to Subcontractors as required by Utah Code § 13-8-5.

8.8.3 WAIVER OF CLAIMS: FINAL PAYMENT. The making of final payment shall constitute a waiver of Claims by DFCM, except those arising from:

8.8.3.1 Liens, Claims, security interests, or encumbrances arising out of the Contract Documents and unsettled;

8.8.3.2 Failure of the Work to comply with the requirements of the Contract Documents;

8.8.3.3 Terms of warranties required by the Contract Documents; or

8.8.3.4 Claims arising within the one-year period for correction of the Work and Claims to the extent not barred by Utah Code § 78B-2-225 and/or Utah Code § 78B-4-513.

8.8.4 DELAYS NOT CONTRACTOR'S FAULT. If, after Substantial Completion of the Work, Final Completion is materially delayed through no fault of Contractor or by issuance of Change Orders affecting final completion, DFCM shall, upon application by Contractor and certification by the A/E, and without terminating Contractor's Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. Such payment shall be made under terms and conditions governing final payment. Unless otherwise stated by DFCM in writing, the making of final payment shall constitute a waiver of claims by DFCM as provided in Section 8.8.3 for that portion of that Work fully completed and accepted by DFCM.

8.8.5 WAIVER BY ACCEPTING FINAL PAYMENT. Acceptance of final payment by Contractor or a Subcontractor shall constitute a waiver of Claims by that payee except those Claims previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 9. TESTS AND INSPECTIONS, SUBSTANTIAL AND FINAL COMPLETION, UNCOVERING, CORRECTION OF WORK AND GUARANTY PERIOD.

9.1 TESTS AND INSPECTIONS.

9.1.1 IN GENERAL. Tests, inspections, and approvals of portions of the Work required by the Contract Documents or by laws, rules, regulations, or orders of public authorities having jurisdiction shall be made at an appropriate time. Unless otherwise specifically set forth in the Contract Documents or agreed to by DFCM in writing, DFCM shall contract for such tests, inspections, and approvals with an independent entity, or with the appropriate public authority, and DFCM shall bear all related costs of tests, inspections, and approvals, except as provided below. If any of the Work is required to be inspected or approved by the terms of the Contract Documents or by any public authority, Contractor shall, at least two (2) working days prior to the time of the desired inspection, and following the procedures established by DFCM, request such inspection or approval to be performed. Contractor shall give the A/E timely notice of when and where tests and inspections are to be made so that the A/E may observe such procedures.

9.1.2 FAILURE OF AN INSPECTOR TO APPEAR. Work shall not proceed without any required inspection and the associated authorization by DFCM to proceed unless the following procedures and requirements have been met:

9.1.2.1 The inspection or approval was requested in a timely manner as provided in Section 9.1.1;

9.1.2.2 Contractor received written confirmation from the inspection entity that the inspection was scheduled;

9.1.2.3 Contractor has contacted or attempted to contact the inspector to confirm whether the inspector is able to perform the inspection as scheduled;

9.1.2.4 If the inspector informs Contractor that the inspector is unable to perform the inspection as scheduled or if Contractor is unable to contact the inspector, Contractor shall attempt to contact the A/E or DFCM for instruction; and

9.1.2.5 Contractor has documented the condition of the Work prior to being covered through photos or other means.

9.1.3 NONCONFORMING WORK. If procedures for testing, inspection, or approval under Section 9.1.1 reveal failure of portions of the Work to comply with the requirements established by the Contract

Documents, Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for DFCM's expenses, including the cost of retesting for verification of compliance if necessary, until DFCM accepts the Work in question as complying with the requirements of the Contract Documents.

9.1.4 CERTIFICATES. Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by Contractor and promptly delivered to the A/E.

9.1.5 A/E OBSERVING. If the A/E is to observe tests, inspections, or approvals required by the Contract Documents, the A/E shall do so with reasonable promptness and, where practicable, at the normal place of testing.

9.1.6 PROMPTNESS. Tests, inspections, and arrangements for approvals conducted pursuant to the Contract Documents shall be made promptly to avoid delay in the Work.

9.2 UNCOVERING OF WORK.

9.2.1 UNCOVER UNINSPECTED WORK. Except as provided in Section 9.2.3, if a portion of the Work is covered prior to an inspector's approval to proceed, it must be uncovered for the inspector's inspection and be replaced at Contractor's expense without change in the Contract Price and/or Contract Time.

9.2.2 OBSERVATION PRIOR TO COVERING. Except as provided in Section 9.2.3, if DFCM or the A/E has requested in writing to observe conditions prior to any Work being covered or if such observation is required by the Contract Documents, and the Work is covered without such observation, Contractor shall be required to uncover and appropriately replace the Work at Contractor's expense without change in the Contract Price and/or Contract Time. If Contractor requests an inspection and DFCM or the A/E, including any inspector of each, does not appear, Contractor shall immediately notify DFCM of such failure to appear, but shall not cover the Work without such inspection.

9.2.3 WHEN AN INSPECTOR FAILS TO APPEAR OR A/E OR DFCM DID NOT MAKE PRIOR REQUEST. If Work is performed by Contractor without an inspection as provided in Section 9.1.2 or if a portion of the Work has been covered which the A/E or DFCM has not specifically requested to observe prior to its being covered or such observation is not required by the Contract Documents, the A/E or DFCM may request to see such Work and it shall be uncovered by Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement, shall, by appropriate Change Order, be charged to DFCM. If such Work is not in accordance with the Contract Documents, Contractor shall pay such costs unless the condition was caused by DFCM or a separate contractor in which event DFCM shall be responsible for payment of such costs.

9.3 INSPECTIONS: SUBSTANTIAL AND FINAL.

9.3.1 SUBSTANTIAL COMPLETION INSPECTION. Prior to requesting a Substantial Completion inspection, Contractor shall prepare a comprehensive initial punchlist, including unresolved items from prior inspections, for review by DFCM and the A/E to determine if the Work is ready for a Substantial Completion inspection. If DFCM and A/E determine that the initial punchlist indicates that the Work is not Substantially Complete, the initial punchlist shall be returned to Contractor with written comments. If DFCM and A/E determines that the initial punchlist indicates that the Work may be Substantially Complete, the A/E shall promptly organize and perform a Substantial Completion inspection in the presence of DFCM and all appropriate authorities.

9.3.1.1 If the A/E reasonably determines that the initial punchlist prepared by Contractor substantially understates the amount of the Work remaining to be completed and the Work is not Substantially Complete, the A/E shall report this promptly to DFCM, and upon concurrence of DFCM, Contractor shall be assessed the costs of the inspection and punchlist review incurred by the A/E and DFCM.

9.3.1.2 When the Work or designated portion thereof is Substantially Complete, the A/E shall prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion; shall establish responsibilities of DFCM and Contractor for security, maintenance, heat, utilities, damage to the Work, and insurance; and shall fix the time within which Contractor shall finish all items on the punchlist accompanying the Certificate (“Punchlist Completion Date”). The Certificate of Substantial Completion shall require approval by DFCM. If there is a punchlist, Contractor shall proceed promptly to complete and correct items on the punchlist. Failure to include an item on the punchlist does not alter the responsibility of Contractor to complete all Work in accordance with the Contract Documents.

9.3.1.3 Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof except to the extent as provided otherwise in the Contract Documents or if such warranty is related to an item where the Work is not complete. Written warranties shall state the length of the warranty, which must comply with the Contract Documents.

9.3.1.4 The Certificate of Substantial Completion shall be submitted by the A/E to DFCM and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.

9.3.1.5 Except to the extent DFCM otherwise approves in advance and in writing, Contractor shall submit the following documents in order to achieve Substantial Completion: written warranties, guarantees, operation and maintenance manuals, and all complete as-built drawings. Contractor shall also provide or obtain any required approvals for occupancy. Contractor shall be responsible for the guaranty of all Work, whether performed by it or by its Subcontractors and Sub-subcontractors at any tier.

9.3.2 FINAL COMPLETION INSPECTION. Prior to requesting a final inspection, Contractor shall verify all punchlist items are corrected and completed. Once all punchlist items are corrected and completed, Contractor shall notify DFCM and request a final inspection. DFCM shall notify the A/E and perform a final inspection. When all punchlist items are completed, a final Application for Payment shall be provided by Contractor, certified by the A/E, and processed by DFCM.

9.3.3 PUNCHLIST COMPLETION. As compensation to DFCM for administrative costs incurred by DFCM as a result of delay in final project close-out, for each day subsequent to the Punchlist Completion Date that Contractor fails to complete the punchlist and subject to Section 8.8.4, Contractor shall pay to DFCM five percent (5%) of the liquidated damages amount stated in the Contractor’s Agreement.

9.4 CORRECTION OF WORK AND GUARANTY PERIOD.

9.4.1 CONTRACTOR CORRECT THE WORK. Contractor shall correct Work rejected by the A/E, an inspector or DFCM, or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. Contractor shall bear the costs of correcting such rejected Work, including additional testing and inspections and compensation for the A/E's and inspector's services and expenses made necessary thereby.

9.4.2 GUARANTY AND CORRECTION AFTER SUBSTANTIAL COMPLETION. If within one year after the date of Substantial Completion of the Work or designated portion thereof, or after the date for commencement of warranties established under Section 9.2.1 or by terms of an applicable special warranty or guaranty required by the Contract Documents, any of the Work is found not to be in accordance with the requirements of the Contract Documents, including failure to perform for its intended purpose, Contractor shall correct it promptly after receipt of written notice from DFCM to do so, unless DFCM has previously given Contractor a written acceptance of such condition. The period of one year shall be extended with respect to portions of the Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work. This obligation of Contractor under this Section 9.4.2 shall be operative notwithstanding the acceptance of the Work under the Contract Documents, the issuance of a final certificate of payment, partial or total occupancy and/or termination of Contractor's Agreement. DFCM shall give notice of observed defects with reasonable promptness; however, failure to give such notice shall not relieve Contractor of its obligation to correct the Work. All corrected Work shall be subject to a one-year guaranty period the same in all respects as the original Work, except that such guaranty period shall commence from the time of Substantial Completion of the corrected Work. This guaranty period does not affect DFCM's right to pursue any available remedies against Contractor, including, but not limited to, DFCM's right to pursue a cause of action for defective construction against Contractor within the time period established by Utah Code § 78B-2-225.

9.4.3 REMOVAL OF WORK.

9.4.3.1 Contractor shall promptly remove from the Work site all Work that DFCM and/or the A/E determines as being in nonconformance with the Contract Documents, whether incorporated or not.

9.4.3.2 Contractor shall promptly replace and re-execute any Work not in accordance with the Contract Documents without change in the Contract Price and/or Contract Time.

9.4.3.3 Contractor shall bear the expense of correcting destroyed or damaged construction, whether completed or partially completed, by DFCM or separate contractors destroyed or damaged by such removal or replacement.

9.4.3.4 If Contractor does not remove such rejected Work within a reasonable time, fixed by written notice, DFCM may have the Work removed and stored at the expense of Contractor.

9.4.3.5 If Contractor does not correct the nonconforming Work within a reasonable time, fixed by written notice, DFCM may correct it in accordance with Section 2.2.2 of these General Conditions.

9.4.4 NOT LIMIT OTHER OBLIGATIONS. Nothing contained in this Section 9.4 shall be construed to establish a period of limitation with respect to other obligations that Contractor may have under the Contract Documents. Establishment of the time period of one year as described in Section 9.4.2 relates only to the specific obligation of Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish Contractor's liability with respect to Contractor's obligations other than specifically to correct the Work.

9.5 ADDITIONAL WARRANTIES.

9.5.1 IN GENERAL. In addition to any other provisions of this Article 9, the following warranties shall apply:

9.5.1.1 Contractor warrants to DFCM that materials and equipment furnished under the Contract Documents shall be of good quality and new, except to the extent otherwise required or expressly permitted by the Contract Documents.

9.5.1.2 Contractor also warrants to DFCM that the Work shall be free from defects not inherent in the quality required or expressly permitted and that the Work shall conform with the requirements of the Contract Documents. Work not conforming to said requirements, including substitutions not implemented by Change Order, Construction Change Directive, or ASI as provided in Article 7, may be considered defective at DFCM's option.

9.5.2 EXCLUSION. Unless due to the negligent or intentional act or omission of Contractor or those under the Contractor's control, or as otherwise stated in the Contract Documents, Contractor's guaranty excludes remedy for damage or defect caused by abuse, modifications not executed by Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.

9.5.3 FURNISH EVIDENCE ON REQUEST. If requested by the A/E or DFCM, Contractor shall furnish satisfactory evidence as to the type and quality of materials and equipment.

9.6 ACCEPTANCE OF NONCONFORMING WORK. If DFCM prefers to accept Work that is not in accordance with the requirements of the Contract Documents, DFCM may do so in writing instead of requiring its removal and correction, in which case the Contract Price shall be reduced as appropriate. Such adjustment shall be effectuated whether or not final payment has been made.

ARTICLE 10. INSURANCE AND BONDS.

10.1 CONTRACTOR'S LIABILITY INSURANCE.

10.1.1 IN GENERAL. The Contractor shall purchase and maintain in a company or companies lawfully authorized to do business in the State of Utah such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by a Sub-subcontractor or anyone directly employed by them, or by anyone for whose acts they may be liable:

10.1.1.1 Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;

10.1.1.2 Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;

10.1.1.3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;

10.1.1.4 Claims for damages insured by usual personal injury liability coverage;

10.1.1.5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;

10.1.1.6 Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;

10.1.1.7 Claims for bodily injury or property damage arising out of completed operations;

10.1.1.8 Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 4.12; and

10.1.1.9 If the Contract Documents require the Contractor to provide and/or the Contractor provides professional services, claims for damages because of negligent errors or omissions in the performance of professional services.

10.1.2 COVERAGE. Without limiting Contractor's obligations or liabilities hereunder, the Contractor shall, at its sole expense, purchase and maintain the following insurance coverages required by Section 10.1.1 of these General Conditions from insurers authorized to do business in the state of Utah and rated "A-" or better with a financial size category of class VII or larger by the A.M. Best Company. The following insurance coverages required by Section 10.1.1 of these General Conditions shall be procured with the following terms and insurance limits unless otherwise agreed in writing by DFCM and the Contractor:

10.1.2.1 Commercial General Liability Insurance covering all liabilities for personal injury and property damage arising in connection with the Work, with limits of liability of Five Million Dollars (\$5,000,000.00) per each occurrence and in the aggregate.

10.1.2.2 Workers Compensation Insurance in compliance with all applicable laws of each jurisdiction in which the Work will be performed.

10.1.2.3 Employers Liability Insurance covering all liabilities for personal injuries of the Contractor's employees, with limits of liability of Five Million Dollars (\$5,000,000.00) for each occurrence and in the aggregate.

10.1.2.4 If the Contract Documents require the Contractor to provide and/or the Contractor provides professional services, Professional Liability Insurance with limits of liability of Two Million Dollars (\$2,000,000.00) for each claim and in the aggregate with a retroactive or effective date not later than the effective date of the Contractor's Agreement and with a deductible or self-insured retention of not greater than One Hundred Thousand Dollars (\$100,000.00) per claim.

10.1.2.5 Automobile Liability Insurance, including coverages of owned, non-owned and hired vehicles covering all liabilities for personal injury and property damage arising from the use of motor vehicles, with combined single limits of liability of Two Million Dollars (\$2,000,000.00) for each occurrence and in the aggregate.

10.1.2.6 If the Contractor is unable to obtain the insurance required by this Section 10.1, Contractor may carry excess liability insurance and/or umbrella insurance that, when combined with Contractor's primary coverage in a given category of insurance, brings the total coverage in such category to be not less than the amount required by this Section 10.1 for that category of insurance.

10.1.3 ENDORSEMENTS. The Contractor shall provide the following coverage endorsements for each category of insurance required by this Section 10.1, except in the case of Workers' Compensation Insurance, Employers' Liability Insurance and Professional Liability Insurance:

10.1.3.1 An endorsement including DFCM as an additional insured;

10.1.3.2 An endorsement including a cross liability clause, noting that each of the parties comprising the insured shall be considered as a separate entity, the insurance applies as if a separate policy has been issued to each party, and no “insured-versus-insured” exclusion exists in the policy.

10.1.3.3 An endorsement waiving all expressed or implied rights of subrogation against DFCM and the State of Utah.

10.1.4 TERMS. Except as otherwise expressly provided in Section 10.1.2, the insurance of the Contractor required to be maintained pursuant to this Section 10.1 shall be on the following terms:

10.1.4.1 All insurance shall begin no later than the effective date of the Contractor’s Agreement and shall continue until the final completion of the Work and for a period of two (2) years following the final completion of the Work, provided, however, if the Contractor’s Agreement is terminated prior to the final completion of the Work, such insurance shall continue for a period of two (2) years following the termination of the Contractor’s Agreement.

10.1.4.2 Before performing any of the Work and after each time the policies are renewed or varied, the Contractor shall provide to DFCM certificates of insurance and endorsements consistent with this Section 10.1.4 and Sections 10.1.1, 10.1.2 and 10.1.3 of these General Conditions. If required by DFCM the Contractor shall deliver copies of the insurance policies providing the insurance coverages required by this Section 10.1, and all endorsements thereto.

10.1.4.3 All insurance shall not be varied to the detriment of DFCM, cancelled or allowed to lapse until thirty (30) days’ prior written notice has been given to DFCM.

10.1.5 FAILURE TO PROVIDE. Should the Contractor at any time neglect or refuse to provide the insurance required by this Section 10.1, or should such insurance be canceled, DFCM shall have the right, but not the obligation, to procure the same at the cost and expense of the Contractor, and the cost thereof may be deducted by DFCM from any monies then due or thereafter to become due to the Contractor. If DFCM or the other Indemnified Parties are damaged by the failure of the Contractor to purchase or maintain insurance as required by this Section 10.1, the Contractor shall bear all reasonable costs, expenses and damages incurred by DFCM and/or the other Indemnified Parties arising from such failure to purchase or maintain the insurance required by this Section 10.1.

10.1.6 CERTIFICATES. The acceptance of delivery of any Certificates of Insurance or copies of insurance policies required to be purchased and maintained pursuant to the Contract Documents does not constitute approval or agreement by the recipient that the insurance requirements have been met or that those Certificates of Insurance or insurance policies comply with the Contract Documents.

10.1.7 NO LIMITATION. The Contractor shall procure such insurance coverages and such insurance limits for its insurance coverages that the Contractor, in its sole discretion, after consultation with its insurance and risk advisors, determines to be sufficient for Contractor’s purposes given the risks of the project. This Section 10.1 sets forth DFCM’s minimum insurance requirements; the Contractor may procure additional or broader insurance coverages or greater insurance limits than required by Section 10.1 at Contractor’s expense. Nothing in Section 10.1 or elsewhere in the Contract Documents is intended to limit the Contractor’s liability to DFCM or the Indemnified Parties to liabilities covered by the insurance coverages required by Section 10.1 or to the minimum insurance limits required of such insurance coverages by Section 10.1.

10.2 “BUILDER’S RISK” INSURANCE.

10.2.1 IN GENERAL. Provided that the Contractor’s Agreement is for new buildings, structures, or construction projects, or for the alteration or repair of, or addition to existing buildings, structures, or improvements (an “Eligible Project”), DFCM shall maintain insurance to protect the interest of the Contractor, Subcontractors, or Sub-subcontractors subject to all of the terms, conditions, limitations, exclusions, waivers and/or endorsements stated in the Commercial Property Policy Declarations and Scheduled Forms available on DFCM’s website, dfcm.utah.gov (“Builder’s Risk Insurance”).

10.2.2 DEDUCTIBLE. To the extent that the Builder’s Risk Insurance provides for a deductible (including, without limitation, a specific loss deductible, cumulative loss deductible and/or sub-deductible), with respect to any damages or losses to property covered by the Builder’s Risk Insurance caused in whole or in part by the negligence, breach of contractual duty or other fault of DFCM (or those for whom DFCM is responsible, including the A/E and the A/E’s consultants) or the Contractor (or those for whom the Contractor is responsible, including the Contractor’s Subcontractors and Sub-subcontractors of any tier), any deductible applicable to such covered damages or losses to property shall be paid by the party, whether DFCM or the Contractor, legally responsible for the negligence, breach of contractual duty or other fault that caused the losses or damages. If both DFCM and the Contractor are legally responsible in part for the negligence, breach of contractual duty or other fault that caused such losses or damages to property, DFCM and the Contractor shall pay any deductible applicable to such covered damages or losses to property in proportion to their comparative fault. With respect to any damages or losses to property covered by the Builder’s Risk Insurance caused by an act of nature, such as the weather or other natural disasters, and not caused in whole or in part by the negligence, breach of contractual duty or other fault of DFCM (or those for whom DFCM is responsible, including the A/E and the A/E’s consultants) or the Contractor (or those for whom the Contractor is responsible, including the Contractor’s Subcontractors and Sub-subcontractors of any tier), DFCM and Contractor shall each pay half of the amount of any deductible to such covered damages or losses to property.

10.2.3 WAIVER OF SUBROGATION. DFCM and Contractor waive all rights against: (1) each other and the other Indemnified Parties and any of their subcontractors, sub-subcontractors, agents and employees, each of the other; and (2) the A/E, A/E’s consultants, separate contractors described in Section 2.2, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent covered by Builder’s Risk Insurance obtained pursuant to Section 10.2.1 and maintained during the course of construction, but only to the extent of the actual recovery of insurance proceeds by the injured party, except such rights as they have to proceeds of such insurance held by DFCM as fiduciary. DFCM or Contractor, as appropriate, shall require of the A/E, A/E’s consultants, separate contractors described in Section 2.2, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged. The waiver of rights under this Section 10.2.3 shall not include: (1) subject to Section 10.2.2, the right to recover amounts deducted or excluded from the insurance proceeds in the form of deductibles paid by the injured party; and (2) claims arising out of design errors or omissions.

10.2.4 SPECIAL HAZARDS. If the Contractor’s Agreement is for an Eligible Project, but Contractor desires insurance coverage for risks other than those covered by the Builder’s Risk Insurance, the Contractor may obtain such insurance, however, the cost thereof shall be borne by the Contractor and shall not be included in the Contract Price.

10.2.5 NON-ELIGIBLE PROJECTS. If the Contractor’s Agreement is not for an Eligible Project, Contractor shall bear the risk of damage and/or loss to Contractor’s materials, equipment and other property,

until acceptance of the Work by DFCM in writing, and no protection from damage and/or loss of the Work (including, without limitation, so called “builders risk”, “course of construction”, “inland marine” and/or similar property insurance) will be provided by DFCM for the protection of Contractor. Contractor may obtain insurance to cover such risks, however, the cost thereof shall be borne by the Contractor and shall not be included in the Contract Price. Section 10.2.3 shall not apply to Non-Eligible Projects.

10.3 PERFORMANCE BOND AND PAYMENT BOND. The Contractor shall furnish a Performance and Payment Bond naming the Contractor as Principal and DFCM and DFCM’s designees as Obligees written on AIA Document A312 (2010) Performance Bond and Labor and Material Payment Bond forms in a penal sum of not less than the Contract Price for the Work as the Contract Price may be modified by Change Order (the “Bonds”). The cost of the Bonds, without mark-up, may be included in the Contract Price. The Contractor shall deliver the Bonds to DFCM at least three (3) days before the commencement of any Work at the Work site. Delivery of the Bonds may be accomplished *via* email. The Bonds shall be procured from a surety authorized to do business in the State of Utah and rated A- or better by the A.M. Best Company at the time of issuance of the Bonds and holding Certificates of Authority as an acceptable surety on federal bonds as listed by the United States Department of Treasury (Circular 570, as amended) in its most recent list at the time of issuance of the Bonds. The penal sum of the Bonds shall be within the maximum specified for such surety in Circular 570, as amended. The attorney-in-fact who executes the Bonds on behalf of the surety shall affix to the Bonds a certified and current copy of his or her power of attorney. If the surety on any of the Bonds furnished by the Contractor is declared a bankrupt or becomes insolvent or its rights to do business are terminated in the State of Utah or it ceases to meet the requirements of this Section 10.3, the Contractor shall within ten (10) calendar days thereafter substitute another bond and surety, both of which must be acceptable to DFCM. Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

ARTICLE 11. MISCELLANEOUS PROVISIONS.

11.1 A/E’S RESPONSIBILITIES. These General Conditions are not intended to provide an exhaustive or complete list of the A/E’s responsibilities. A separate agreement between DFCM and the A/E incorporates these General Conditions by reference and includes additional design and contract administration responsibilities.

11.2 SUCCESSORS AND ASSIGNS. DFCM and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to the other party hereto and to partners, successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in the Contract Documents. Contractor shall not assign Contractor’s Agreement without the prior written consent of DFCM, nor shall Contractor assign any amount due or to become due or any of Contractor’s rights under the Contract Documents, without prior written consent of DFCM.

11.3 WRITTEN NOTICE.

11.3.1 PERSONAL DELIVERY AND REGISTERED OR CERTIFIED MAIL. Written notice shall be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an officer of the corporation for which it was intended, or if delivered at or sent by registered or certified mail, return receipt requested, to the last business address known to the party giving notice.

11.3.2 E-MAIL. Notwithstanding any other provision of these General Conditions, written notice shall also be deemed to have been duly served by verified use of an e-mail system by using the known and operative e-mail address of the intended recipient. Service by use of the e-mail system is encouraged when timely notice shall benefit DFCM, the A/E, or Contractor. Notice shall be considered complete and verified upon the sending and confirmation of delivery using the e-mail system, if on the same day notice is also sent by registered or

certified mail, return receipt requested, to the last business address known to the party giving notice, confirming the e-mail delivery.

11.4 RIGHTS AND REMEDIES.

11.4.1 NOT LIMIT. 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.

11.4.2 NO WAIVER. Except as expressly provided elsewhere in the Contract Documents, no action or failure to act by DFCM, the A/E, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract Documents, nor shall such action or failure to act constitute approval or acquiescence in a breach thereunder, except as any of the above may be specifically agreed to in writing. In no case shall Contractor or any Subcontractors be entitled to rely upon any waiver of any of these General Conditions, unless agreed to in writing by DFCM.

11.5 NO DISCRIMINATION, NO SEXUAL HARASSMENT. Pursuant to the laws of the United States and the State of Utah, Contractor, Subcontractors, or anyone for whose act any of them may be liable, shall take affirmative action to not discriminate against any employee or applicant for employment because of race, creed, color, sex, religion, ancestry or national origin. To the extent applicable, said persons shall comply with all provisions of Executive Order No. 11246 dated September 24, 1965 and rules, regulations, orders, instructions, designations and other directives promulgated pursuant thereto. Contractor, Subcontractors, or anyone for whose act any of them may be liable, shall not act in any manner as would violate the laws, regulations, and policies of the United States or the State of Utah prohibiting sexual harassment.

11.6 APPLICABLE LAWS AND ENFORCEMENT. The Contract Documents shall be governed by and construed in accordance with the laws of the State of Utah, excluding any choice of law provisions that would otherwise require application of laws of any other jurisdiction.

11.7 INTERPRETATION. In the interest of brevity, the Contract Documents frequently omit modifying words such as “all” and “any” and articles such as “the” and “an”, but the fact that a modification or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

11.8 VENUE. In case of any dispute that may arise under the Contract Documents, the place of venue shall be in the County of Salt Lake, State of Utah, unless otherwise agreed to by all of the parties in writing.

11.9 SEVERABILITY. The invalidity of any provision or part of a provision of the Contract Documents shall not impair or affect in any manner the validity, enforceability, or effect of the remainder of the Contract Documents.

11.10 CONSTRUCTION OF WORDS. Unless otherwise stated in the Contract Documents, words which have well-known technical or construction industry meanings shall be construed as having such recognized meanings. Unless the context requires otherwise, all other technical words shall be construed in accordance with the meaning normally established by the particular, applicable profession or industry. All other words, unless the context requires otherwise, shall be construed with an ordinary, plain meaning.

11.11 NO THIRD-PARTY RIGHTS. These General Conditions create rights and duties only as between DFCM and Contractor, and DFCM and A/E. Nothing contained herein shall be deemed as creating third party beneficiary contract rights or other actionable rights or duties as between Contractor and A/E, or as between DFCM, Contractor, or A/E on the one hand, and any other person or entity.

ARTICLE 12. TERMINATION OR SUSPENSION OF THE CONTRACT.

12.1 TERMINATION BY CONTRACTOR FOR CAUSE.

12.1.1 IN GENERAL. If the Work is stopped for a period of sixty (60) days through no act or fault of the Contractor or a Subcontractor, or their agents or employees or any other persons performing portions of the Work under contract with any of the above, the Contractor may terminate the Contractor's Agreement in accordance with Section 12.1.2 for any of the following reasons:

12.1.1.1 Because DFCM has persistently failed to fulfill material obligations of DFCM under the Contract Documents with respect to matters important to the progress of the Work;

12.1.1.2 Issuance of an order of a court or other public authority having jurisdiction which necessitates such termination, except that where the Contractor has standing, the Contractor must cooperate in efforts to stay and/or appeal such order;

12.1.1.3 An act of government, such as a declaration of national emergency, making material unavailable; or

12.1.1.4 Unavoidable casualties or other similar causes.

12.1.2 NOTICE. If one of the reasons for termination in Section 12.1.1 exists, the Contractor may, upon fourteen (14) additional days' written notice to DFCM and A/E, and such condition giving cause for termination still not cured, terminate Contractor's Agreement and recover from DFCM payment for Work properly executed as of the date of termination, including profit and overhead on Work properly completed as of the date of termination, on a percentage completion basis, along with Contractor's reasonable demobilization expenses incurred within seven (7) days of termination, but Contractor shall in no event be entitled to recover consequential damages as a result of such termination or profit and/or overhead on the Work not executed.

12.2 TERMINATION BY DFCM FOR CAUSE.

12.2.1 IN GENERAL. DFCM may terminate the Contractor's Agreement if Contractor fails to cure any of the following within a period of seven (7) days (or longer if DFCM so approves in writing) after receipt of notice from DFCM specifying the breach or failure:

12.2.1.1 Contractor refuses or fails to supply enough properly skilled workers or proper materials;

12.2.1.2 Contractor fails to make payment to Subcontractors for materials, equipment, or labor;

12.2.1.3 Contractor disregards laws, ordinances, rules, regulations, or orders of a public authority having jurisdiction;

12.2.1.4 Contractor fails to perform the Work such that the Work will be Substantially Completed within the Contract Time or Contractor fails to make progress with the Work as required by the Contract Documents;

12.2.1.5 Contractor fails to perform the Work in accordance with the Contract Documents or is otherwise in breach of a material provision of the Contract Documents;

12.2.1.6 As permissible by law for a reason to terminate, Contractor is adjudged bankrupt;

12.2.1.7 As permissible by law for a reason to terminate, Contractor should make a general assignment for the benefit of creditors;

12.2.1.8 As permissible by law for a reason to terminate, Contractor should have a receiver appointed on account of Contractor's insolvency; or

12.2.1.9 Contractor fails to follow safety requirements and precautions either as expressly provided in the Contract Documents or as consistent with the customary practices in the industry.

12.2.2 DFCM'S RIGHT TO CARRY OUT THE WORK UPON TERMINATION FOR CAUSE. If Contractor fails to remedy the breach or failure within seven (7) days or other mutually agreed period after notice from DFCM, DFCM may, without prejudice to other remedies available to DFCM and in addition to enforcement of any other of DFCM's rights, terminate the Contractor's Agreement, take possession of the Work site and all materials, finish the Work by whatever reasonable method DFCM may deem expedient, and charge Contractor, or file a claim against Contractor's bankruptcy estate, for any additional costs incurred by DFCM to complete the Work. Contractor shall not be entitled to receive any further payment until the Work is completed, nor shall Contractor be relieved from its obligations and liabilities assumed under the Contractor's Agreement. If DFCM's costs exceed the amount of any payment(s) owed by DFCM to Contractor subject to offset by DFCM, DFCM may bill Contractor for the difference, which Contractor shall pay within twenty-eight (28) days of receipt of DFCM's invoice.

12.2.3 ITEMS REQUIRED TO BE TRANSFERRED OR DELIVERED. DFCM may require Contractor to transfer title and deliver to DFCM, in the manner and to the extent directed by DFCM:

12.2.3.1 Any completed portion of the Work; and

12.2.3.2 Any partially completed portion of the Work and any parts, tools, dies, jigs, fixtures, drawings, information, and contract rights as Contractor has specifically produced or specifically acquired for the performance of such part of the Work as has been terminated; and Contractor shall, upon direction of DFCM, protect and preserve property in the possession of Contractor in which DFCM has an interest.

12.2.4 PAYMENT. When DFCM terminates Contractor's Agreement for one or more of the reasons stated in Section 12.2.1, DFCM may withhold payment and/or pursue all available remedies.

12.2.5 DFCM PROTECTION IF LIENABLE. When the Work is lienable, DFCM may withhold from amounts otherwise due Contractor for such Work such amount as DFCM determines to be necessary to protect the State against loss because of liens.

12.2.6 CREDITS AND DEFICITS. If the unpaid balance of the Contract Price exceeds the full cost of finishing the Work, including compensation for the A/E's services and expenses made necessary thereby, such excess shall be paid to Contractor. If such cost exceeds the unpaid balance of the Contract Price, Contractor shall pay the difference to DFCM and this obligation for payment shall survive the termination of Contractor's Agreement.

12.2.7 IF CONTRACTOR FOUND NOT IN DEFAULT OR EXCUSABLE. If, after notice of termination of Contractor's Agreement under the provisions of Section 12.2, it is determined for any reason that Contractor was not in default under the provisions of Section 12.2, or that the default was excusable under the provisions of Section 12.2, the rights and obligations of the parties shall be the same as if the notice of termination had been issued pursuant to the termination for convenience provisions of Section 12.3.

12.2.8 RIGHTS AND REMEDIES NOT EXCLUSIVE. The rights and remedies of DFCM provided in this Section 12.2 shall not be exclusive and are in addition to any other rights and remedies provided by law or under the Contract Documents.

12.2.9 TIME PERIOD FOR CLAIMS. Any PRE by Contractor for adjustment under this Section 12.2 must be asserted by Contractor, in writing, within twenty-one (21) days from the date of termination; provided that DFCM may, in its sole discretion, receive and act upon any such PRE asserted at any time prior to final payment under Contractor's Agreement.

12.3 TERMINATION FOR CONVENIENCE OF DFCM.

12.3.1 IN GENERAL. The performance of Work under Contractor's Agreement may be terminated by DFCM in accordance with this Section 12.3 in whole or in part, or from time to time, whenever DFCM shall determine that such termination is in the best interest of DFCM or any person or entity for whom DFCM is acting under Contractor's Agreement. Any such termination shall be effectuated by delivery to Contractor of a notice of termination specifying the extent to which performance of Work is terminated and the date upon which such termination becomes effective.

12.3.2 CONTRACTOR OBLIGATIONS. After receipt of a notice of termination, and except as otherwise directed by DFCM in writing, the Contractor shall:

12.3.2.1 Stop Work under Contractor's Agreement on the date and to the extent specified in the notice of termination;

12.3.2.2 Place no further orders or subcontracts for materials, services or facilities, except as may be necessary for completion of such portion of the Work that is not terminated;

12.3.2.3 Terminate all orders and subcontracts to the extent that they relate to performance of Work terminated by the notice of termination;

12.3.2.4 Assign to DFCM in the manner, at the times, and to the extent directed by DFCM, all of the right, title, and interest of Contractor under the orders and subcontracts so terminated, in which case DFCM shall have the right, in its discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts;

12.3.2.5 Settle all outstanding liabilities and all claims arising out of such termination of orders and subcontracts, with the approval or ratification of DFCM, which approval or ratification shall be final for all the purposes of this Section 12.3;

12.3.2.6 Transfer title and deliver to DFCM in the manner, at the times, and to the extent, if any, directed by DFCM:

12.3.2.6.1 The fabricated or unfabricated parts, Work in process, completed Work, supplies, and other material produced as a part of, or acquired in connection with the performance of the Work terminated by the notice of termination; and

12.3.2.6.2 The completed or partially completed drawings, information, and other property which, if Contractor's Agreement had been completed, would have been required to be furnished to DFCM;

12.3.2.7 Use best efforts to sell, in the manner, at the times, to the extent, and at the price or prices directed or authorized by DFCM, any property of the types referred to in Section 12.3.2.6; provided, however, that Contractor:

12.3.2.7.1 Shall not be required to extend credit to any purchaser; and

12.3.2.7.2 Shall dispose of any such property under the conditions prescribed by and at a price or prices approved by DFCM; and provided further that the proceeds of any such transfer of or disposition shall be applied in reduction of any payments to be made by DFCM to Contractor under Contractor's Agreement or shall otherwise be credited against the Contract Price or paid in such other manner as DFCM may direct;

12.3.2.8 Complete performance of such part of the Work as shall not have been terminated by the notice of termination; and

12.3.2.9 Take such action as may be necessary, or as DFCM may direct, for the protection and preservation of the property related to Contractor's Agreement which is in the possession of Contractor in which the State of Utah has or may acquire an interest.

12.3.3 TERMINATION CLAIM. After receipt of a notice of termination, Contractor may submit to DFCM a PRE, in the form and with certification prescribed by DFCM. Such PRE shall be submitted promptly but in no event not later than twenty-one (21) days from the effective date of termination.

12.3.4 AGREED UPON PAYMENT. Subject to the provisions of Section 12.3.3 above, Contractor and DFCM may agree upon the amount to be paid to Contractor by reason of the total or partial termination of Work pursuant to this Section 12.3.

12.3.5 PAYMENT NOT AGREED UPON. In the event Contractor and DFCM fail to agree as provided in Section 12.3.4 upon the whole amount to be paid to Contractor by reason of the termination of Work pursuant to this Section 12.3, DFCM shall pay to the Contractor the amounts determined by DFCM as follows, but without duplication of any amounts agreed upon in accordance with Section 12.3.4:

12.3.5.1 With respect to all Work performed prior to effective date of termination, the total (without duplication of any items) of:

12.3.5.1.1 The cost of such Work including undisputed Claim amounts;

12.3.5.1.2 The cost of terminating, settling and paying claims arising out of the termination of Work under subcontracts or orders as provided in Section 12.3.2.5, exclusive of the amounts paid or payable on account of supplies or materials delivered or services furnished by Subcontractors prior to the effective date of termination under Contractor's Agreement, which amounts shall be included in the cost on account of which payment is made under Section 12.3.5.1.1;

12.3.5.1.3 An amount, as overhead and profit on Section 12.3.5.1.1 above, determined by DFCM to be fair and reasonable;

12.3.5.1.4 The reasonable cost of the preservation and protection of property incurred pursuant to Section 12.3.2.9; and any other reasonable cost incidental to termination of Work, including expenses incidental to the determination of the amount due to Contractor as the result of the termination of Work.

12.3.5.1.5 The total amount to be paid to Contractor under Section 12.3.5.1 above shall not exceed the Contract Price as reduced by the amount of payments otherwise made and as further reduced by the Contract Price of Work not terminated. Except for normal spoilage, and except to the extent that DFCM shall have otherwise expressly assumed the risk of loss in writing, there shall be excluded from the amounts payable to Contractor under Section 12.3.5.1 above, the fair value of property which is destroyed, lost, stolen, or damaged so as to become undeliverable to DFCM, or to a buyer pursuant to Section 12.3.2.7.

12.3.6 DEDUCTIONS. In arriving at the amount due Contractor under this Section 12.3, there shall be deducted:

12.3.6.1 All unliquidated advance or other payments on account theretofore made to the Contractor, applicable to the terminated portion of Contractor's Agreement;

12.3.6.2 Any Claim which DFCM and/or the State of Utah may have against Contractor in connection with Contractor's Agreement; and

12.3.6.3 The agreed price for, or the proceeds of sale of, any materials, supplies, or other things acquired by Contractor or sold, pursuant to the provisions of this Section 12.3, and not otherwise recovered by or credited to DFCM.

12.3.7 PARTIAL TERMINATION. If the termination is partial, Contractor may file with DFCM a PRE for the amounts specified in Contractor's Agreement relating to the continued portion of Contractor's Agreement and such equitable adjustment as may be agreed upon shall be made in such amounts. Any PRE under this Section 12.3.7 must be filed within twenty-one (21) days from the effective date of the partial termination.

12.3.8 PARTIAL PAYMENTS. DFCM may, from time to time, under such terms and conditions as it may prescribe, make partial payments and payments on account against costs incurred by Contractor in connection with the terminated portion of Contractor's Agreement whenever, in the opinion of DFCM, the aggregate of such payments shall be within the amount to which Contractor shall be entitled hereunder. If the total of such payments is in excess of the amount finally agreed or determined to be due under this Section 12.3, such excess shall be payable by Contractor to DFCM upon demand, together with interest at a rate stated in Utah Code § 15-1-1, for the period until the date such excess is repaid to DFCM; provided, however, that no interest shall be charged with respect to any such excess payment attributable to a reduction in Contractor's claim by reason of retention or other disposition of termination inventory until fourteen (14) days after the date of such retention or disposition, or such later date as determined by DFCM by reason of the circumstances.

12.3.9 PRESERVE AND MAKE AVAILABLE RECORDS. Unless otherwise provided for in Contractor's Agreement, or by applicable law, Contractor shall, from the effective date of termination until the expiration of three years after final settlement under Contractor's Agreement, preserve and make available to DFCM at all reasonable times at the office of Contractor, but without charge to DFCM, all books, records, documents, and other evidence bearing on the costs and expenses of Contractor under Contractor's Agreement and relating to the Work terminated hereunder, or, to the extent approved by DFCM, photographs, or other authentic reproductions thereof.

12.3.10 SUSPENSION, DELAY OR INTERRUPTION OF WORK BY DFCM FOR CONVENIENCE. DFCM may in writing and without cause, order Contractor to suspend, delay, or interrupt the Work, in whole or in part, for such period of time as DFCM may determine to be appropriate for the convenience of DFCM.

12.4 DFCM'S RIGHT TO STOP THE WORK. If Contractor fails to correct Work or fails to carry out Work as required by the Contract Documents or fails to comply with all required and customary safety precautions; DFCM, in writing, may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of DFCM to stop the Work shall not give rise to a duty on the part of DFCM to exercise this right for the benefit of Contractor or any other person or entity.

SECTION 010000 – GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes general requirements that are to apply to all Work throughout the Project. Requirements included in this Section are to apply to all other specification Sections.
- B. Refer to Construction Agreement for other requirements by the General Contractor, Subcontractors, suppliers, etc.

1.3 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Center of...": Indicates a specific single point at the exact center of the tile, panel, or other surface indicated.
- D. "Contractor": The General Contractor unless otherwise stated.
- E. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "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."
- H. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- I. "Project Manager": The Contractor's project manager.

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- J. "Project Representative": The Owner's project representative(s).
- K. "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.
- L. "Provide": Furnish and install, complete and ready for the intended use.
- M. "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.
- N. "Related Sections": Related Sections articles are included herein as a courtesy to assist in the locating of items in the specifications that the reader might expect to find in the Section but that are specified elsewhere. The list of sections may or may not be complete. 'Related Sections' articles do not relieve the Contractor of the contractual obligation to perform to all the Contract Documents or to coordinate who does what amongst the team of subcontractors.

1.4 SITE INSPECTION

- A. Examine the premises and site and compare them with the drawings and specifications.
- B. Become familiar with existing conditions such as obstructive areas, excavating or filling, and any problems related to construction. No allowances will subsequently be made by reason of failure to examine the site.

1.5 SCOPE OF THE WORK

- A. See Division 01 Section 01100 "Summary" for an overall general summary of the Work.
- B. Unless otherwise provided, all materials, labor, equipment, tools, transportation, and utilities necessary for the successful completion of the Project shall be provided at the expense of the Contractor.
- C. Requirements of the Work are contained in the Contract Documents, and include cross-references herein to published information, which is not necessarily bound therewith.
- D. Provide, as part of the Bid and without additional charge, all incidental items required for completion of the Work, even if not specifically indicated.
 - 1. Install all Work so that its several component parts function together as a complete and workable system, and with all equipment properly adjusted and in working order.
- E. Conform to highest quality standards for materials and workmanship to execute Work that is indicated or specified and that is necessary to fully satisfy the Contract Document requirements for a complete, finished, acceptable installation regardless of whether indicated or specified or not.

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- F. Responsibilities of the Contractor includes the responsibility to verify all field measurements of actual building conditions so that all Work fits properly in the locations indicated and specified. Protect existing structures, improvements, trees, and other items from physical damage, unless identified to be removed.
- G. Any existing surfaces, furniture or equipment that are damaged by the Contractor are to be restored to their original condition, or better, to the satisfaction of the Owner.
- H. Contractor is to restore any roads, utilities, walks, curbs, gutters or other existing conditions that are used for construction and are damaged, to the same condition as they existed prior to commencement of construction. Where existing conditions are damaged, they shall be replaced by new Work to match existing adjacent Work, or repaired, if acceptable to Project Representative, at no cost to Owner.

1.6 WORKERS

- A. The Contractor is to enforce strict discipline and good order among his/her employees at all times and shall not employ on the Project any unfit person or anyone not skilled in the Work assigned to him/her.
- B. Consumption of alcohol, smoking or any other controlled, non-medically prescribed substance will not be allowed on the Project.
- C. Contractor shall rectify behavior unacceptable to the Owner or Owner's Project Representative by strict enforcement of discipline. Owner reserves the right to request dismissal of individual workers for failure to comply with standards of behavior communicated to the Contractor.

1.7 MANUFACTURER'S DIRECTIONS

- A. Manufactured articles, materials, or equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with the Manufacturer's printed directions unless otherwise indicated in the Contract Documents.

1.8 FASTENERS

- A. Unless noted otherwise, the trade requiring the fastening of its Work to any substrate or support is responsible for provision and installation of requisite fasteners.

1.9 PENETRATIONS

- A. The sealing of all penetrations in fire-rated, acoustically-rated or structural partitions and separations is the responsibility of the trade making or requiring the penetration.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01100

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Deferred Submittals.
 - 4. Access to site.
 - 5. Work Restrictions
 - 6. Specification and drawing conventions.

1.3 PROJECT INFORMATION

- A. Project Identification: **Utah State University - Taggart Student Center - The Skyroom Remodel**
 - 1. Project Location: Approximately 650 N 800 E, Logan, UT 84322
- B. Owner: Division of Facilities and Construction Management
4315 South 2700 West, Floor 3.
Taylorsville, Utah 84129
- C. Architect: ajc architects;
703 East 1700 South
Salt Lake City, Utah 84105
Ph#: 801.466.8818
Contact: Jill Jones
- D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
 - 1. Structural
ARW Engineers
1594 W Park Cir #100
Ogden, UT 84404
1.801.782.6008
Contact: Justin Naser

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2. Mechanical/Plumbing:
VBFA
40 W Cache Valley Blvd. Bldg. 1, Ste. B
Logan, Utah 84341
1.801.478.1086
Contact: Ray Vernon
3. Electrical:
Spectrum Engineers
324 South State Street, Ste. 400
Salt Lake City, Utah 84111
1.801.401.8416
Contact: Matthew J. Haverkamp

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Contract Documents and consists of the following:
 1. Project Description:
 - a. New tenant improvement within the USU Taggart Student Center – The Skyroom located on the 4th level. Project includes new restrooms, renovated dining spaces, commercial kitchen and updated floor, ceiling and wall finishes. All walls go to structural deck and constructed as acoustical walls. See finish schedule for new finishes.
 - b. Contractor shall field verify and measure the areas intended for improvement including mechanical, plumbing and electrical systems. Report any discrepancies to the Architect before proceeding with construction.

1.5 DEFERED SUBMITTALS

- A. The deferred submittal must include all necessary details and specific information relating to the materials, type, size, etc. as necessary to fabricate and install the deferred submittal item.
- B. All nonstructural component deferred submittals should be submitted in one single package or in groups by discipline. As an example, at no time should multiple submittals be provided for the seismic restraint of mechanical items, such as separate submittals for equipment, ductwork, piping, etc.
- C. No deferred submittal items are to be installed until approval has been granted by the Building Official.
- D. The following will be deferred:
 1. Building fire sprinkler system upgrades.
 2. Building fire alarm system upgrades.
 3. Aluminum curtainwall system.

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4. Glazing systems.

1.6 ACCESS TO SITE

- A. Unrestricted Use of Site: Each Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
 1. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- 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.

1.7 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
- B. On-Site Work Hours: Limit work to between 7:00 a.m. to 6:00 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.
- C. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- D. Smoking and Controlled Substance Restrictions: Use of tobacco products, vaping products, alcoholic beverages, and other controlled substances on Project site **is not permitted**.

1.8 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.

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3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 4. 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 and published as part of the U.S. National CAD Standard.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 1000

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Sections:
 - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
 - 2. Divisions 02 through 49 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Owner.

1.4 SUBMITTALS

- A. Substitution Requests: Submit electronic submittal of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use attached standard Substitution Request Form along with attached Product Substitution Checklist.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication, or installation cannot be provided, if applicable.

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- b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven (7) days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within **15 days** of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Owner's Change Order form, Owner's Construction Change Directive form, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

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1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

- A. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than **15 days** prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received prior to the issuance of the last addenda during the bidding period. Requests received after that time may be considered or rejected at discretion of Architect.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

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LOGAN, UTAH 84321

- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
- b. Requested substitution does not require extensive revisions to the Contract Documents.
- c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
- d. Substitution request is fully documented and properly submitted.
- e. Requested substitution will not adversely affect Contractor's construction schedule.
- f. Requested substitution has received necessary approvals of authorities having jurisdiction.
- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SUBSTITUTION REQUEST

(After the Bidding/Negotiating Phase)



PROJECT: _____ SUBSTITUTION REQUEST NUMBER: _____
TO: _____ FROM: _____
RE: _____ DATE: _____
A/E PROJECT NUMBER: _____
CONTRACT FOR: _____

SPECIFICATION TITLE: _____ DESCRIPTION: _____
SECTION: _____ PAGE: _____ ARTICLE/PARAGRAPH: _____

PROPOSED SUBSTITUTION: _____
MODEL NO.: _____ PRODUCT AGE: New Product 1-4 years old 5-10 years old More than 10 years old
MANUFACTURER: _____
ADDRESS: _____ PHONE: _____
INSTALLER: _____
ADDRESS: _____ PHONE: _____
DIFFERENCES BETWEEN PROPOSED SUBSTITUTION AND SPECIFIED PRODUCT: _____
 Point-by-point comparative data attached — REQUIRED BY A/E

REASON FOR NOT PROVIDING SPECIFIED ITEM: _____

SIMILAR INSTALLATION:
PROJECT: _____ ARCHITECT: _____
ADDRESS: _____ OWNER: _____
DATE INSTALLED: _____

EXPLAIN HOW PROPOSED SUBSTITUTION WILL AFFECT OTHER PARTS OF WORK: _____

SUBSTITUTION WILL:
SAVE OWNER: \$ _____ CHANGE CONTRACT TIME (SPECIFY DAYS ADDED OR SUBTRACTED): _____

SUPPORTING DATA ATTACHED: Drawings Product Data Samples Tests Reports _____

CONTINUE ON NEXT PAGE



SUBSTITUTION REQUEST

(After the Bidding/Negotiating Phase—Continued)

By signing this form, the undersigned represents that:

- The proposed substitution:
 - Will perform the same as the specified product;
 - Has the same or more extensive warranties as the specified product;
 - Requires the same or less maintenance as the specified product;
 - Has as many or more sources of replacement as the specified product;
 - Will not affect dimensions or functional clearances in this Project; and
 - Will not adversely affect other trades or delay the progress schedule for this Project.
- The cost data in this form is complete. The undersigned will, if the proposed substitution is accepted and is later found to have directly caused additional costs (e.g., changes to building design, A/E design, detailing, construction costs), pay those costs.
- The undersigned will, if the proposed substitution is accepted, coordinate, install, and change the Work as necessary.

SUBMITTED BY: _____

SIGNED BY: _____

FIRM: _____

ADDRESS: _____

TELEPHONE: _____

Attachments

A/E'S REVIEW AND RECOMMENDATION:

- Substitution approved—Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures and prepare Change Order.
- Substitution approved as noted—Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures and prepare Change Order.
- Substitution rejected—Use specified materials.
- Substitution Request received too late and is rejected—Use specified materials.

SIGNED BY: _____ **DATE:** _____

OWNER'S REVIEW AND RECOMMENDATION:

- Substitution approved—Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures and prepare Change Order.
- Substitution approved as noted—Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures and prepare Change Order.
- Substitution rejected—Use specified materials.

SIGNED BY: _____ **DATE:** _____

ADDITIONAL COMMENTS: Contractor Subcontractor Supplier Manufacturer A/E

PRODUCT SUBSTITUTION CHECKLIST



DATE: _____ RE: _____
A/E NUMBER: _____ MANUFACTURER'S PROJECT NUMBER: _____
FILING NO.: _____ CONTRACT FOR: _____

PRODUCT EQUIVALENCE:

- Is the submitted product equivalent to the specified item? _____
- Does it serve the same function? _____
- Does it have the same dimensions? _____
- Does it have the same appearance? _____
- Will it last as long? _____
- Does it comply with the same codes, and standards and performance requirements? _____
- Has the product been used locally, and where are the projects? _____

- Has a problem occurred with the product, and what was the remedy? _____

EFFECT ON THE PROJECT:

- Will the substitution affect other aspects of the construction? _____
- Are any details affected and are changes required? _____
- What is the cost of the changes? _____
- Who pays for the required changes? _____
- Is construction time affected? _____

EFFECT ON THE WARRANTY:

- How does the proposed warranty differ from the specified warranty? _____

- Does the manufacturer have a track record of standing behind the warranty? _____

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue to GC supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710 ASI Form.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue to GC a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 10 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.

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- d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect and Owner or form provided as part of web-based Project management software.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, CM/GC may initiate a claim by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 7. Proposal Request Form: Use **DFMC Proposal Request Form**.
- 1.5 CHANGE ORDER PROCEDURES
- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and GC on **DFCM Change Order Form**.
- 1.6 CONSTRUCTION CHANGE DIRECTIVE
- A. Construction Change Directive: Architect may issue a Construction Change Directive on **DFCM Construction Change Directive Form**. Construction Change Directive instructs GC to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

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AIA[®] Document G710[™] – 2017

Architect's Supplemental Instructions

PROJECT: *(name and address)*

CONTRACT INFORMATION:

Contract For:

Date:

ASI INFORMATION:

ASI Number:

Date:

OWNER: *(name and address)*

ARCHITECT: *(name and address)*

CONTRACTOR: *(name and address)*

The Contractor shall carry out the Work in accordance with the following supplemental instructions without change in Contract Sum or Contract Time. Proceeding with the Work in accordance with these instructions indicates your acknowledgment that there will be no change in the Contract Sum or Contract Time.

(Insert a detailed description of the Architect's supplemental instructions and, if applicable, attach or reference specific exhibits.)

ISSUED BY THE ARCHITECT:

ARCHITECT *(Firm name)*

SIGNATURE

PRINTED NAME AND TITLE

DATE

DFCM

Division of Facilities Construction and Management
4110 State Office
Building Salt Lake City, UT 84114
Telephone (801) 538-3018 FAX (801) 538-3267

Proposal Request No. 1

Date Requested **1-1-06**

Owner	Division of Facilities and Construction Management	Contractor	XYZ Construction 123 S. Main Street SLC, Utah 84114
Project		DFCM Project No.	

This is NOT a Change Order nor a directive to proceed with the Work described herein. Please submit an itemized quotation for changes in the Contract Sum and/or Contract Time incidental to proposed modifications to the Contract Documents described herein. Submit proposal within seven days, or notify the Architect in writing of the date on which you anticipate submitting your proposal.

Description:

Attachments:

Attribution:

- DFCM Contingency
- CM/GC Contingency
- Agency Funds

Requested by:
ABC Architecture

Architect/Engineer
Project Manager

Distribution: Owner Joe DFCM
Owner Joe Agency
Architect ABC Architecture
Consultant ABC Engineering
Consultant
Contractor XYZ Construction

DFCM Change Order Form

Original Contractual Dates

Fill in the gray boxes with the required project information then select a Change Order number from the drop down below to display the corresponding approved PCOs and amounts from the PCO log.

NTP Date	Substantial Date	Total Days
1/0/1900	1/0/1900	-

Change Order
 Project Name
 Agency
 Contractor

Date
 Project Number
 Contract Number
 A/E

PCO Number	Description of Work	Amount	Reason Code	Days
Total This Change Order		\$0.00		-

	Dollars	Date	Days
Original Contract	\$0.00	January 0, 1900	-
Total Previous Change Orders	\$0.00		-
Total This Change Order	\$0.00		-
Adjusted Contract	\$0.00	January 0, 1900	-

This change order is issued under the following conditions:

- This work is to be performed in strict accordance with the terms of the Contract Documents, including prior issued Change Orders and Construction Change Directives, except as modified by this Change Order.
- The rights of the DFCM (State of Utah) are not prejudiced.
- The Contractor agrees that the terms, contract sum, scope of the Work and time specified in this Change Order shall constitute the full accord and satisfaction, and complete adjustment to the Contract and includes all direct and indirect costs and effects related to, incidental to, a consequence of and/or reasonably implied from such change in the contract terms, sum, scope of the Work and time.
- Documents submitted with this Change Order are hereby incorporated as part of the Contract Documents for this Project.
- This change order is not effective until executed by the DFCM below.
- Signature of the Contractor below indicates agreement herewith.

THE TERMS AND CONDITIONS OF THIS CHANGE ORDER ARE HEREBY ACCEPTED:

DATE

Contractor: _____
 Architect/Engineer: _____
 Agency/Institution: _____
 DFCM Project Manager: _____

ARCHITECT: _____
AGENCY OR INSTITUTION: _____
PROJECT NAME: _____
PROJECT NUMBER: _____
CONTRACTOR: _____
DATE: _____

In order to expedite the work and avoid or minimize delays in the work which may affect the contract sum or contract time, the contract documents are hereby amended as described below. Proceed with this work promptly. Submit final costs for work involved and change in contract time (if any), for inclusion in a subsequent Change Order, per paragraph 7.3 of the General Conditions.

Root Cause:

(insert here)

Description:

(insert here)

Attachments (insert listing of documents that support the description):

(insert here)

Proposed method of determining change in the contract sum, per paragraph 7.2 and 7.3 of the General Conditions:

_____ (NTE – PCO with all backup to be submitted ASAP)

Architect/Engineer	_____	Date
DFCM	_____	Date
Agency Rep	_____	Date
Contractor	_____	Date

SECTION 012900 – PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

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- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one-line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's Project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 5. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
 6. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
 7. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
 8. Schedule of Values Revisions: Update and resubmit before the schedule of values before the next Application for Payment, when Change Orders or Construction

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Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use **DFCM Application and Certificate for Payment** as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.

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- c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Products list (preliminary if not final).
 6. Submittal schedule (preliminary if not final).
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal consultants.
 9. Copies of building permits.
 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 11. Initial progress report.
 12. Report of preconstruction conference.
 13. Certificates of insurance and insurance policies.
 14. Performance and payment bonds.
 15. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

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1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 - 4. DFCM Project Closeout Checklist**
 - 5. DFCM Consent of Surety to Final Payment.**
 - 6. DFCM Application and Certificate for Payment**
 7. Evidence that claims have been settled.
 8. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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Division of Facilities Construction and Management

DFCM

Application and Certificate for Payment #

TO: State of Utah - Division of Facilities Construction and Management
State Office Building Room 4110
PO Box 141160
Salt Lake City, Utah 84114-1160
ATTN:
FROM:
PERIOD FROM :
PERIOD TO:
PROJECT #
PROJECT NAME
CONTRACT #:

Contractor's Certificate for Payment

I, (), after being duly sworn, do depose and say that:
1. I have conducted a diligent investigation in accordance with customary practices in the industry of the subject Work covered by this Application and Certification for Payment and to the best of my knowledge, such work is in accordance with the Contract Documents;
2. Contractor has fully paid all Subcontractors and suppliers covered whose work is reflected in prior Applications, except as as described in an attachment to this Application. Any such attachment shall describe the amount and the detailed reason(s) for nonpayment;
3. The Current payment Due in this Application is in fact due to the Contractor under the Contract Documents;
4. Contractor will promptly and fully pay all Subcontractors and suppliers whose work is reflected in this approved Application, including retainage and interest as required under Utah law, within ten (10) days of receipt by the Contractor;
5. The Contractor will diligently pursue obtaining any payment waivers from subcontractors or suppliers as requested by DFCM; and
6. If any facts discovered after payment under this Application indicate that there has been an overpayment, that Contractor will promptly return such overpaid amount to DFCM.

Contractor's Application for Payment

Contractor makes the application for payment based on the information in this form, including the attached Schedule of Values

- 1 Original Contract Sum:
2 Net Change by Approved Change Orders/CCD"s as listed in the Schedule of Values:
3 Adjusted Contract Sum (1+/-2):
4 Total Completed and Stored to Date:
5 Retainage:
a. Previous Application:
b. This Application:
c. Total Retainage (5a + 5b):
6 Total Earned Less Retainage (4 -5c):
7 Prior Certificates For Payment:
8 Current Payment Due Contractor:
9 Balance to Complete Project, Including Retainage:

Contractor/Affiant Title
STATE OF UTAH)
:SS.
COUNTY OF)
SUBSCRIBED AND SWORN to me this _____ day of _____
Notary Public: _____ My Commission Expires: _____

A/E's Certificate for Payment

In accordance with the Contract Documents and the A/E Agreement, based on on-site observations and the data comprising this application, A/E certifies that, to the best of the A/E's knowledge, information and belief, the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment the amount certified. If amount certified differs from the amount applied for, attach a detailed explanation with a copy to the contractor.

A/E: _____ Date: _____ Amount Certified: _____
DFCM: _____ Date: _____ Amount Approved: _____

This application is not negotiable or assignable. The Amount Approved is payable only to the Contractor named herein. Issuance, payment, and acceptance of payment are subject to the rights, terms and obligations of Contract Documents.

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
 - 4. Section 019115 "Building Enclosure Commissioning Requirements".

1.3 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

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1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 2. Number and title of related Specification Section(s) covered by subcontract.
 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, in web-based Project software directory (if one is set-up), and in prominent location in built facility. Keep list current at all times.

1.5 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. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with 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 with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. 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 and separate contractors if coordination of their Work is required.

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- D. 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.
 - 9. Project close-out activities.

- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.

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- g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
 - 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 - 2. Plenum Space: Indicate sub-framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 - 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 - 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 - 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 - 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 - 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 - 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

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9. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Preparation Format: DWG, Version 18, operating in Microsoft Windows operating system.
 3. File Submittal Format: Submit or post coordination drawing files using PDF format.
 4. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project. When included in construction contract.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
 5. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in Revit – 2017 Format.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.
- 1.7 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. Architect will return without response those RFIs submitted to Architect 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. Project number.

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3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject (description).
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. 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: **DFCM RFI Form.**
1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect 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 Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum 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 Sum, notify Architect in writing within 10 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:

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1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect'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 Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Digital data files of Architect's will be provided by Architect, if requested by the Contractor's, for use during construction. The Contractor will have to complete and sign an ajc electronic files release form prior to any digital documents released.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Digital Drawing Software Program: Contract Drawings are available in Revit 2017.
 - a. Subcontractors, and other parties working with the Contractor on this project may request Architect's digital data files, but must also complete and sign an ajc electronic files release form, prior to any digital documents released. No one is given the right to release ajc Architects digital files except ajc Architects.
 4. Upon request, The following digital data files will be furnished for each appropriate discipline:
 - a. Floor plans.
 - b. Reflected ceiling plans.
- B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.

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3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 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 Architect of scheduled meeting dates and times a minimum of 10 working days prior to meeting. Record attendees on **DFCM Meeting Attendance Log**.
 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 on **DFCM Meeting Minutes Form**. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days after the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 1. Attendees: Authorized representatives of Owner, Architect, 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 Applications for Payment.
 - k. Distribution of the Contract Documents.
 - l. Submittal procedures.
 - m. LEED Documentation & Submittals.
 - n. Preparation of Record Documents.
 - o. Use of the premises.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.

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- t. Procedures for moisture and mold control.
 - u. Procedures for disruptions and shutdowns.
 - v. Construction waste management and recycling.
 - w. Parking availability.
 - x. Office, work, and storage areas.
 - y. Equipment deliveries and priorities.
 - z. First aid.
 - aa. Security.
 - bb. Progress cleaning.
 - cc. Commissioning Requirements.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes using DFCM Meeting Form.
- 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 Architect 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. LEED Documentation & Submittals
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.

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- aa. Commissioning Requirements.
 - 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. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 45 days prior to the scheduled date of Substantial Completion.
 - 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Submittal of written warranties.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for delivery of material samples, attic stock, and spare parts.
 - g. Requirements for demonstration and training.
 - h. Preparation of Contractor's punch list.
 - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - j. Submittal procedures.
 - k. Owner's partial occupancy requirements.
 - l. Installation of Owner's furniture, fixtures, and equipment.
 - m. Responsibility for removing temporary facilities and controls.
 - 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

- E. Progress Meetings: Conduct progress meetings at weekly intervals.
 - 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

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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) LEED Documentation & Submittals
 - 18) Commissioning Requirements.
 - 19) Pending claims and disputes.
 - 20) 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.
5. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

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- F. Coordination Meetings: Conduct Project coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Status of RFIs.
 - 15) Proposal Requests.
 - 16) Change Orders.
 - 17) Pending changes.
 - 18) LEED Documentation & Submittals
 - 19) Commissioning Requirements.
 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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DFCM

Division of Facilities Construction and Management
4110 State Office
Building Salt Lake City, UT 84114
Telephone (801) 538-3018 FAX (801) 538-3267

Request For Information No. 1

Date Requested **1-1-24**

Owner	Division of Facilities and Construction Management	Contractor	XYZ Construction 123 S. Main Street SLC, Utah 84114
Project		DFCM Project No.	

(For Contractor's Use)

Date Required _____

Subject: Request for Information on _____ TITLE OF SUBJECT

Description:

Suggested Resolution:

(For Engineer's Use)

Date of response _____

Subject: Request for Information on _____ TITLE OF SUBJECT

Description:

Distribution: Owner (x) Joe DFCM
Owner (x) Joe Agency
Architect (x) ABC Architecture
Consultant (x) ABC Engineering
Consultant ()
Contractor (x) XYZ Construction
Other ()

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Unusual event reports.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting schedules and reports.
 - 2. Section 014000 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

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- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF file.
 - 3. Approval of cost-loaded start-up construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- B. Startup construction schedule.
 - 1. Submittal of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 - 3. Total Float Report: List of activities sorted in ascending order of total float.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at monthly intervals Applications for Payment.

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- G. Material Location Reports: Submit at monthly intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.
- I. Unusual Event Reports: Submit at time of unusual event.

1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Discuss constraints, including work stages, area separations, interim milestones and partial Owner occupancy.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review schedule for work of Owner's separate contracts.
 - 6. Review submittal requirements and procedures.
 - 7. Review time required for review of submittals and resubmittals.
 - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 9. Review and finalize list of construction activities to be included in schedule.
 - 10. Review procedures for updating schedule.

1.6 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

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- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Commissioning Time: Include no fewer than 15 days for commissioning.
 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 3. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use-of-premises restrictions.
 - f. Seasonal variations.
 - g. Environmental control.
 4. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.

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- j. Adjusting.
 - k. Curing.
 - l. Startup and placement into final use and operation.
- 5. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Completion of mechanical installation.
 - d. Completion of electrical installation.
 - e. Substantial Completion.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion and the following interim milestones:
 - 1. Temporary enclosure and space conditioning.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and the Contract Time.
- G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule at each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. As the Work progresses, indicate final completion percentage for each activity.
- H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- I. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.

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2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.8 STARTUP CONSTRUCTION SCHEDULE

- A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.9 CPM SCHEDULE REQUIREMENTS

- A. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Punch list and final completion.
 - k. Activities occurring following final completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

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- B. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

- C. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.
 - 2. Description of activity.
 - 3. Main events of activity.
 - 4. Immediately preceding and succeeding activities.
 - 5. Early and late start dates.
 - 6. Early and late finish dates.
 - 7. Activity duration in workdays.
 - 8. Total float or slack time.
 - 9. Average size of workforce.
 - 10. Dollar value of activity (coordinated with the schedule of values).

- D. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 - 1. Identification of activities that have changed.
 - 2. Changes in early and late start dates.
 - 3. Changes in early and late finish dates.
 - 4. Changes in activity durations in workdays.
 - 5. Changes in the critical path.
 - 6. Changes in total float or slack time.
 - 7. Changes in the Contract Time.

1.10 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. Testing and inspection.
 - 7. Accidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events.
 - 10. Stoppages, delays, shortages, and losses.
 - 11. Meter readings and similar recordings.
 - 12. Emergency procedures.
 - 13. Orders and requests of authorities having jurisdiction.
 - 14. Change Orders received and implemented.
 - 15. Construction Change Directives received and implemented.

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16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final completion construction photographs.
 - 4. Construction video recordings (Optional).
 - 5. Web-based construction photographic documentation (Optional).
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting photographic documentation.
 - 2. Section 017700 "Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.
 - 3. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 INFORMATIONAL SUBMITTALS

- A. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Digital Camera: Minimum sensor resolution of 8 megapixels.
 - 2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
 - 3. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of General Contractor (GC).
 - e. Date photograph was taken.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier keyed to accompanying key plan.

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- B. Construction Photographs: Submit one print of each photographic view within seven days of taking photographs.
 - 1. Format: 8-by-10-inch smooth-surface matte prints on single-weight, commercial-grade photographic paper; enclosed in clear plastic sleeves that are punched for standard three-ring binder.
 - 2. Identification: On back of each print, provide an applied label or rubber-stamped impression with the following information:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of GC
 - e. Date photograph was taken if not date stamped by camera.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier keyed to accompanying key plan.

- C. Video Recordings, at contractor's option: Submit video recordings within seven days of recording.
 - 1. Submit video recordings in digital video disc format acceptable to Architect by posting to Project Web site.
 - 2. Identification: With each submittal, provide the following information:
 - a. Name of Project.
 - b. Name and address of photographer.
 - c. Name of Architect.
 - d. Name of GC
 - e. Date video recording was recorded.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Weather conditions at time of recording.
 - 3. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, three-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as corresponding video recording. Include name of Project and date of video recording on each page.

- D. Web-Based Photographic Documentation, at contractor's option: Provide link for real time web cam video recordings.

1.4 QUALITY ASSURANCE

- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

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- B. Web-Based Photographic Documentation Service Provider: A firm specializing in providing photographic equipment, Web-based software, and related services for construction projects, with record of providing satisfactory services similar to those required for Project.

1.5 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.
- B. Digital Video Recordings: Provide optional high-resolution, digital video disc in format acceptable to Architect.

2.2 WEB-BASED PHOTOGRAPHIC DOCUMENTATION (Optional)

- A. Project Camera: Provide fixed exterior camera installation, mounted to provide unobstructed view of construction site from location approved by Architect.
 - 1. Provide one or two fixed-location camera(s), with the following characteristics:
 - a. Static view.
 - b. Capable of producing minimum 3.0-megapixel pictures.
 - c. Provide power supply, active high-speed data connection to service provider's network, and static public IP address for each camera.
- B. Web-Based Image Access: Password-protected access for Project team administered by Contractor, providing current image access and archival image access by date and time, with images downloadable to viewer's device.
 - 1. Provide public viewer open access to most recent project camera image.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Provide a qualified photographer to take construction photographs.

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- B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 1. Date and Time: Include date and time in file name for each image.
 - 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.
- D. Preconstruction Photographs: Before commencement of excavation, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Flag excavation areas and construction limits before taking construction photographs.
 - 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- E. Periodic Construction Photographs: Take 20 photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- F. Architect-Directed Construction Photographs: From time to time, Architect will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- G. Final Completion Construction Photographs: Take 20 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.
 - 1. Do not include date stamp.
- H. Additional Photographs: Architect or Owner may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
 - 1. Three days' notice will be given, where feasible.
 - 2. In emergency situations, take additional photographs within 24 hours of request.

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3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.

3.2 CONSTRUCTION VIDEO RECORDINGS (Optional)

- A. Video Recording Photographer: Engage a qualified videographer to record construction video recordings.
- B. Recording: Mount camera on tripod before starting recording unless otherwise necessary to show area of construction. Display continuous running time and date. At start of each video recording, record weather conditions from local newspaper or television and the actual temperature reading at Project site.
- C. Preconstruction Video Recording: Before starting excavation, record video recording of Project site and surrounding properties from different vantage points, as directed by Architect.
 1. Flag excavation areas and construction limits before recording construction video recordings.
 2. Show existing conditions adjacent to Project site before starting the Work.
 3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of excavation. Show protection efforts by Contractor.
- D. Periodic Construction Video Recordings: Record optional video recording weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last video recordings were recorded. Minimum recording time shall be 30 minutes(s).

3.3 WEB-BASED CONSTRUCTION PHOTOGRAPHIC DOCUMENTATION (Optional)

- A. Live Streaming Construction Site Images: Provide Web-accessible image of current site image from fixed location camera(s), updated at 15-minute intervals during daytime operation.
- B. Time-Lapse Sequence Construction Site Recordings: Provide video recording from a fixed-location camera to show status of construction and progress.

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1. Frequency: Record one frame of video recording every 15 minutes, from same vantage point each time, to create a time-lapse sequence of construction activities.
 2. Timer: Provide timer to automatically start and stop video recorder so recording occurs only during daylight construction work hours.
- C. Maintain cameras and Web-based access in good working order according to Web-based construction photographic documentation service provider's written instructions until final completion. Provide for service of cameras and related networking devices and software.

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Submittal schedule requirements.
- 2. Administrative and procedural requirements for submittals.

- B. Related Requirements:

- 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
- 2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
- 3. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

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1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled dates for installation.
 - i. Activity or event number.

1.5 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
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 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 Architect.

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- 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 Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.6 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
- 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. Architect 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 Architect'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 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect 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 15 days for review of each resubmittal.

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4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
- 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 Architect'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 Architect's action stamp.

1.7 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.

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5. Submit Product Data before Shop Drawings, and before or concurrent 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 unless submittal based on Architect's digital data drawing files is otherwise permitted.
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 kind, 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. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
 4. Paper Transmittal: Include paper transmittal 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 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

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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. Architect 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 architects 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.

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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 Welding Procedure Specification and Procedure Qualification Record 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 primers and substrate preparation needed for adhesion.
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.

1.8 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.

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1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file, paper copies 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.
 2. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.

- C. BIM Incorporation: Incorporate delegated-design drawing and data files into BIM established for Project.
 1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.

1.9 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 Architect.

- 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. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required.
 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
 2. Paper Submittals: Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

- B. Informational Submittals: Architect will review each submittal and will not return it or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

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- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will discard submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

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SUBMITTAL TRANSMITTAL



PROJECT: _____ DATE: _____
 _____ A/E PROJECT NUMBER: _____

TRANSMITTAL A

TO (CONTRACTOR): _____ DATE: _____ SUBMITTAL NO.: _____
 FROM (SUBCONTRACTOR): _____ BY: _____ RESUBMISSION

QTY.	REFERENCE / NUMBER	TITLE / DESCRIPTION / MANUFACTURER	SPEC. SECTION TITLE AND PARAGRAPH / DRAWING DETAIL REFERENCE

- | | |
|--|---|
| <input type="checkbox"/> Submitted for review and approval | <input type="checkbox"/> Substitution involved - Substitution request attached |
| <input type="checkbox"/> Resubmitted for review and approval | <input type="checkbox"/> If substitution involved, submission includes point-by-point comparative data or preliminary details |
| <input type="checkbox"/> Complies with contract requirements | <input type="checkbox"/> Items included in submission will be ordered immediately upon receipt of approval |
| <input type="checkbox"/> Will be available to meet construction schedule | |
| <input type="checkbox"/> A/E review time included in construction schedule | |

Other remarks on above submission: _____ One copy retained by sender

TRANSMITTAL B

TO (A/E): _____ ATTN: _____ DATE REC'D BY CONTRACTOR: _____
 FROM (CONTRACTOR): _____ BY: _____ DATE TRNSMT'D BY CONTRACTOR: _____

- | | |
|--|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Revise / Resubmit |
| <input type="checkbox"/> Approved as noted | <input type="checkbox"/> Rejected / Resubmit |

Other remarks on above submission: _____ One copy retained by sender

TRANSMITTAL C

TO (CONTRACTOR): _____ ATTN: _____ DATE REC'D BY CONTRACTOR: _____
 FROM (A/E): _____ BY: _____ DATE TRNSMT'D BY CONTRACTOR: _____

- | | | |
|--|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Rejected / Resubmit | <input type="checkbox"/> Provide file copy with corrections identified |
| <input type="checkbox"/> Approved as noted | <input type="checkbox"/> No action taken or required | <input type="checkbox"/> Reproducible copies only returned |
| <input type="checkbox"/> Revise and Resubmit | <input type="checkbox"/> Not required for review | <input type="checkbox"/> Point-by-point comparative data required to complete approval process |
| | <input type="checkbox"/> Submission Incomplete / Resubmit | |

Other remarks on above submission: _____ One copy retained by sender

TRANSMITTAL D

TO (SUBCONTRACTOR): _____ ATTN: _____ DATE REC'D BY CONTRACTOR: _____
 FROM (CONTRACTOR): _____ BY: _____ DATE TRNSMT'D BY CONTRACTOR: _____

COPIES: Owner Consultants _____ _____ _____ _____ One copy retained by sender

AGREEMENT CONCERNING DRAWING FILES ON ELECTRONIC MEDIA-CONTRACTOR

At your request, we will provide electronic files for your convenience and use for the project, subject to the following terms and conditions:

Our electronic files (BIM model or other CAD files) are compatible with REVIT 2020 or AutoCAD 2020. We make no representation as to the compatibility of these files with your hardware or your software beyond the specified release of the referred specifications.

Data contained on these electronic files are part of our instruments of service and shall not be used by you or anyone else receiving these data through or from you for any purpose other than as a convenience for the referenced project. Any other use or reuse by you or by others will be at your sole risk and without liability or legal exposure to ajc architects and the consulting engineers for this project. You agree to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against us, our officers, directors, employees, agents or subconsultants that may arise out of or in connection with your use of the electronic files.

Furthermore, you shall, to the fullest extent permitted by law, indemnify and hold us harmless against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising out of or resulting from your use of these electronic files.

These electronic files are not construction documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. We make no representation regarding the accuracy or completeness of the electronic files you receive. Revit models may not include all design elements necessary for completing the project. In the event that a conflict arises between the signed or sealed hardcopy construction documents prepared by ajc architects and consulting engineers, and the electronic files, the signed or sealed hard-copy construction documents shall govern. You are responsible for determining if any conflict exists. By your use of these electronic files, you are not relieved of your duty to fully comply with the contract documents, including, and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of other contractors for the project.

Because information presented on the electronic files can be modified, unintentionally or otherwise, all title blocks, and other references to ajc architects, our consulting engineers and the owner(s) shall be removed. If used as submittal documents, submittals will be rejected if non-compliant.

Under no circumstances shall delivery of the electronic files for use by you be deemed a sale by us, and we make no warranties, either express or implied, of merchantability and fitness for any particular purpose. In no event shall we be liable for any loss of profit or any consequential damages as a result of your use or reuse of these electronic files. The drawings files provided by ajc architects and consulting engineers may not be reproduced or distributed to individuals outside the company or collective organization signing this agreement.

Project Name: _____
ajc architects Project Number: _____
List of Revit Models: _____
List of CAD Files: _____

Contractor: _____
Contractor Representative: _____
Signature: _____
Date: _____

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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.
- C. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for developing a schedule of required tests and inspections.
 - 2. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 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: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

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- 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 trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Laboratory Mockups: Full-size physical assemblies constructed and tested at testing facility to verify performance characteristics.
 - 2. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting.
- 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.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to 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: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as 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.

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1.4 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.

1.5 CONFLICTING REQUIREMENTS

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

1.6 ACTION SUBMITTALS

- A. Shop Drawings: For mockups.
 - 1. Include plans, sections, and elevations, indicating materials and size of mockup construction.
 - 2. Indicate manufacturer and model number of individual components.
 - 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
- B. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, 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.

1.7 INFORMATIONAL SUBMITTALS

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

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

1.8 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, unless otherwise indicated, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

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1. Contractor-performed tests and inspections including Subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.9 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 reinspection.
- 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.

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3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include 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 whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

1.10 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. 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 are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

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1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

- H. 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.

- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens and test assemblies, and mockups, and laboratory mockups; do not reuse products on Project.

 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

- K. 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. Coordinate with Architect.
 2. Build mockups in location indicated or, if not indicated, as directed by Architect.

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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 that 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. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
8. Demolish and remove mockups when directed unless otherwise indicated or is to become part of the finished work.

1.11 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. Payment for these services will be made from testing and inspection allowances, as authorized by Change Orders.
 3. Costs for retesting and reinspection construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: 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 shall 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.

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- C. Retesting/Reinspection: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspection, 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. Associated Contractor 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. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspection equipment at Project site.

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- 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.

1.12 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency / special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.
 - 1. Notify Architect and Owner of any irregularities or deficiencies in the work observed in the performance of its services.
 - 2. Submit certified written report of each test, inspection and similar quality control service to Architect and Owner.
 - 3. Submit final report of special tests and inspections at substantial completion including a list of unresolved deficiencies.

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 reference during normal working hours.

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.

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

END OF SECTION 014000

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for Temporary facilities and controls, including temporary utilities support facilities and security and protection facilities.
- B. Responsibility for temporary facilities will be assigned to the Contractor.
- C. Temporary utilities include, but are not limited to, the following:
 - 1. Water service distribution.
 - 2. Sanitary facilities, including toilets.
 - 3. Ventilation.
 - 4. Electric power distribution service.
 - 5. Lighting.
- D. Support facilities include, but are not limited to, the following:
 - 1. Temporary project identification signs (approved by Owner).
 - a. Include sign design.
 - 2. Waste disposal facilities.
 - 3. Field offices.
- E. Security and protection facilities include, but are not limited to, the following:
 - 1. Temporary Enclosures for existing construction.
 - 2. Existing utilities.
- F. Related Sections:
 - 1. Section 013300 "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule.
 - 2. Section 015800 "Project Identification" for project signage.
 - 3. Section 017300 "Execution" for progress cleaning requirements.
 - 4. Division 02 through 33 for temporary heat, ventilation and humidity requirements for products in those Sections.

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1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities 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: Pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 3. Indicate sequencing of work that requires water, 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.

1.5 SUBMITTALS

- A. Implementation and termination Schedule: Within 10 days of date established for submittal of Contractor's Construction Schedule, submit a schedule indicating implementation.

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1.6 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities", and , NFPA241
 - 1. TRAD Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulation and union jurisdictions.
 - 2. Electric Service: Comply with NECA, NEMA and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- C. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

1.7 PROJECT CONDITIONS

- A. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
 - 1. Keep temporary services and facilities clean and neat.
 - 2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Portable Chain-Link Fencing and Gates: Minimum 2-inch, 9-gauge thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide concrete bases for supporting posts.
- C. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.
- D. Water: Potable.
- E. Wood Studs, Vis-queen, Walk-off Dust mats.

2.2 EQUIPMENT

- A. General: Provide equipment suitable for use intended.

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1. Field Offices: Mobile units with lockable entrances, operable windows and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.
- B. Fire Extinguishers: Hand carried, portable, UL rated; with class and extinguishing agent as required by locations or a combination of extinguishers of NFPA-recommended classes for exposures. classes of fire exposures.
 1. Comply with HFFPA 10 and HFFPA 241 for classification, extinguishing agent and size requirement by location and class of fire exposure.
- C. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- D. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110 to 120 v plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- E. Power distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125V ac, 20A rating, and lighting circuits may be nonmetallic sheathed cable.

PART 3 - EXECUTION

3.1 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 from site until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 1. Locate field offices, sanitary facilities and other temporary construction and support facilities for easy access.
 2. Provide incombustible construction for offices located within construction area or within 30 feet of building lines. Comply with NFPA 241.
 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.

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- B. Project Identification and Temporary Signs: Project identification and other signs requires Owner's approval. Install signs at locations where Owner has approved and is acceptable by authorities of jurisdiction. Do not permit installation of unauthorized signs.
 - 1. Refer to Section 015800 "Project Identification" for signage requirements.
 - 2. Content and location of direction signs will be at the direction of the Owner.
 - 3. Maintain and touchup signs so they are legible at all times.
- C. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous or unsanitary waste materials separately for other waste. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.
- E. Common-use Field Office: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel at project site. Keep office clean and orderly.
 - 1. Provide fluorescent light fixtures capable of maintaining average illumination of 20 fc at desk height. Provide 110 to 120 V duplex outlets spaced at not more than 12-foot intervals, 1 per wall in each room.
- F. Storage and Fabrication Sheds: provide sheds sized, furnished and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on site.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. 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.
- B. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- C. Barricades, Warning Signs, and Lights: Comply with standards and code required, structurally adequate barricades, including warning signs and lighting. Paint with appropriate colors, graphics and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.

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3.4 OPERATION, TERMINATION AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- 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 delays because of interference with temporary facility. Repair damaged work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. At substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning procedures.

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. 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.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.3 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. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process 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. 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.

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- 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, if applicable.

1.4 ACTION SUBMITTALS

- A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Architect's Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 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.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- 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.

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1.6 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 to determine that products are undamaged and properly protected.
- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 6. Protect stored products from damage and liquids from freezing.
 - 7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

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1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. 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 the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," or "or approved substitution" comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Evaluation of "or equal" product status is by the Architect; whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase: "Subject to compliance with requirements, provide the following: ..."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

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- a. Sole manufacturer/source may be indicated by the phrase: "Subject to compliance with requirements, provide products by the following: ..."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."
4. 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, which 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: ..."
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
6. 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, which 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: ..."
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product match.

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1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or 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 these 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. Detailed comparison of significant qualities of proposed product with those named in the Specifications. 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.
 2. Evidence that proposed product provides specified warranty.
 3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 4. Samples, if requested.
- B. Submittal Requirements: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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. Installation of the Work.
- 3. Cutting and patching.
- 4. Coordination of Owner-installed products.
- 5. Progress cleaning.
- 6. Starting and adjusting.
- 7. Protection of installed construction.
- 8. Correction of work.

- B. Related Requirements:

- 1. Section 013300 "Submittal Procedures" for submitting surveys.
- 2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.3 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.

1.4 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
 - 1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result

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from cutting and patching work. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

- a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.6 QUALITY ASSURANCE

- A. 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, 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. Plumbing piping systems.
 - e. Mechanical systems piping and ducts.
 - f. Control systems.
 - g. Communication systems.
 - h. Electrical wiring systems.
 - i. 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

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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. Equipment supports.
 - d. Piping, ductwork, vessels, and equipment.
 - e. 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.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place 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.

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, and water-service piping; underground electrical services; and other utilities.

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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.
 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. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

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3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General:
 - 1. Establish limits on use of Project site.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.

3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- F. 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.
- G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.

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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.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Repair or remove and replace damaged, defective, or nonconforming Work.
1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.5 CUTTING AND PATCHING

- A. Cutting and Patching, 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. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. 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,

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- 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. 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.
- H. 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. 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 minimize 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. 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.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

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3.6 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

- A. General: 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 (27 deg C).
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

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- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: 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 017419 "Construction Waste Management and Disposal."
- 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. Coordinate startup and adjusting of equipment and operating components.
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: 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.

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3.10 CORRECTION OF THE WORK

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

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Recycling nonhazardous demolition and construction waste.
 - 2. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- C. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for the Notice to Proceed.

1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:

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1. Material category.
 2. Generation points of waste.
 3. Total quantity of waste in tons.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Qualification Data: For waste management coordinator.

1.7 QUALITY ASSURANCE

- A. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
1. Review and discuss waste management including responsibilities of each contractor and waste management coordinator.
 2. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 3. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 4. Review waste management requirements for each trade.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials including, but not limited to, the following:
1. Construction Waste:
 - a. Metals.
 - b. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Wood pallets.
 - 8) Plastic pails.

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PART 3 - EXECUTION

3.1 IMPLEMENTATION

- A. General: Implement waste management. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.

3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

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3.3 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

3.4 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for progress cleaning of project site.
 - 2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 3. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.
 - 4. Divisions 02 through 49 sections for specific closeout and special cleaning requirements for the work in these sections.

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.

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- C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in 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 Architect. 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 Architect's signature for receipt of submittals.
5. Submit testing, adjusting, and balancing records.
6. 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.

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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; if any.
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 7 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 according to 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 shall 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.

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.

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1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- 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.
 - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. 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. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - 1. Submit on digital media acceptable to Architect.
- E. Warranties in Paper Form:
 - 1. Provide one (1) set and bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

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3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- F. 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, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - d. Remove snow and ice to provide safe access to building.
 - e. 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.

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- f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - g. Sweep concrete floors broom clean in unoccupied spaces.
 - h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - 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 and mortar 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.
 - 1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
 - o. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - p. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls" AND Section 017419 "Construction Waste Management and Disposal".

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.

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- a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals. 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. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.

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- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning authority 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. Architect and Commissioning Authority will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 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.

1.6 REQUIREMENTS FOR OPERATION AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.

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5. Name and contact information for Contractor.
 6. Name and contact information for Architect.
 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 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.
- 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:

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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.

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.

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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 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Division 02 through 49 Sections for specific requirements for project record documents of the work in those sections.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one of file prints.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one set(s) of prints.

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- c. Final Submittal:
 - 1) Submit record digital data files and one set of record digital data file plots.
- B. Record Specifications: Submit one paper copy annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. 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.
- E. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 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.
 - 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. Locations and depths of underground utilities.
 - d. Revisions to routing of piping and conduits.
 - e. Revisions to electrical circuitry.
 - f. Actual equipment locations.
 - g. Duct size and routing.
 - h. Locations of concealed internal utilities.
 - i. Changes made by Change Order or Construction Change Directive.
 - j. Changes made following Architect's written orders.

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- k. Details not on the original Contract Drawings.
 - l. Field records for variable and concealed conditions.
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 sets 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 Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. resolution.
 4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
- a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.

1.5 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file.

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1.6 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.
- 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.

1.7 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.

1.8 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 Architect's reference during normal working hours.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.
- B. Related Sections:
 - 1. Divisions 02 through 49 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 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.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Instructional Manuals and Materials: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name of Architect.
 - c. Name of General Contractor.

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2. Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, three-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date training sessions.
3. At completion of training, submit complete training manual(s) for Owner's use and videos with narration.

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 1. Inspect and discuss locations and other facilities required for instruction.
 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 3. Review required content of instruction.
 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

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PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if 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. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.

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- 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.

2.2 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
1. At beginning of each training module, record each chart containing learning objective and lesson outline.

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- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.
 - 1. Submit video recordings on CD-ROM or thumb drive.
 - 2. File Hierarchy: Organize folder structure and file locations in accordance with Project Manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged in accordance with Project Manual table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while or dubbing audio narration off-site after video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

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PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between 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.
 - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish Contractor with names and positions of required training participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, with at least seven days' advance notice.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- E. 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.
- F. Deliver video recordings to Owner

END OF SECTION 017900

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
3. Section 017300 "Execution" for cutting and patching procedures.
4. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

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1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection. Indicate proposed locations and construction of barriers.
- D. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
- E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

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1.7 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.8 FIELD CONDITIONS

- A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Hazardous material remediation is specified in the Contract Documents.
 - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of measured drawings preconstruction photographs or video and templates.
 - 1. Inventory and record the condition of items to be removed and salvaged.
 - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

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3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - e. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - f. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

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1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain fire watch during and for at least Three (3) hours after flame-cutting operations.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- ### 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS
- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

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- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.9 SELECTIVE DEMOLITION SCHEDULE

- A. Remove: Refer to demolition plans.

END OF SECTION 024119

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SECTION 054300 - SLOTTED CHANNEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Slotted Channel Framing:

- a. Framing shall be a strut type metal framing system (Strut System).
- b. Strut System shall be used:
 - 1) To support exhibits, equipment and devices.
 - 2) For structural applications as applicable.
- c. Strut System and components must be supplied from a single approved Manufacturer.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Structural calculations by a Registered Professional or Structural Engineer in the State of the Project's location for approval by the Professional of Record. Calculations may include, but are not limited to:

- 1. Description of design criteria
- 2. Stress and deflection analysis
- 3. Selection of framing members, fittings, and accessories

- B. Assembly drawings necessary to install the Strut System in compliance with the Contract Drawings

- C. Pertinent manufacturers published data

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All material is to be delivered to the work site in original factory packaging to avoid damage to the finish.
- B. Upon delivery to the work site, all components shall be protected from the elements by a shelter or other covering.

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1.5 WARRANTY

- A. Manufacturer shall warrant for 1 year from the shipment date that products will be free from defects in material or manufacture. In the event of any such defect in violation of the warranty, Manufacturer shall have the option to repair or replace any such defective product.
- B. Installer shall warrant for 1 year from the date of completion of work that the work will be free of defects in installation. In the event of any such defect in violation of the warranty, Installer shall have the option to repair or replace any such defective product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Unistrut P1000T or an approved substitution meeting the requirements of this section.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel trusses.
- B. Structural Performance: Provide cold-formed steel slotted channel system capable of withstanding design loads within limits and under conditions indicated:
 - 1. Minimum Section Properties:
 - a. Material = ASTM A570 Gr. 33
 - b. Section Width = 1.5/8"
 - c. Section Height = 1.5/8"
 - d. Material Thickness = 12 guage
 - e. Moment of Inertia (I) = 0.185 in⁴
 - f. Section Modulus (S) = 0.202 in³
 - 2. Hanger Spacing: 5'-0"x 5'-0" max grid.
 - 3. Allowable Loads on Unistrut Grid: See Structural.

2.3 FINISHES

- A. Factory Painted
 - 1. Channel
 - a. Rust inhibiting thermoset acrylic enamel paint applied by electrodeposition after cleaning and phosphating, and thoroughly baked.
 - 2. Fittings

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- a. Polyester powder coat after cleaning and phosphating, and thoroughly baked.
- 3. Color: Black
- 4. Hardness = 2H
- 5. Performance
 - a. Salt Spray per ASTM B117 (1) Scribed: Exceed 400 hours (2) Unscribed: Exceed 600 hours
 - b. Nominal chalking at 1,000 hours per weatherometer G-23 test
 - c. No checking at 1,000 hours per weatherometer G-23 test

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The installer shall inspect the work area prior to installation. If work area conditions are unsatisfactory, installation shall not proceed until satisfactory corrections are completed.

3.2 INSTALLATION

- A. Installation shall be accomplished by a fully trained manufacturer authorized installer.
- B. Set Strut System components into final position true to line, level and plumb, in accordance with approved drawings.
- C. Anchor material firmly in place, and tighten all connections to their recommended torques.

3.3 CLEANUP

- A. Upon completion of this section of work, remove all protective wraps and debris. Repair any damage due to installation of this section of work.

3.4 PROTECTION

- A. During installation, it shall be the responsibility of the installer to protect this work from damage.
- B. Upon completion of this scope of work, it shall become the responsibility of the general contractor to protect this work from damage during the remainder of construction on the project and until substantial completion.

END OF SECTION 054300

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SECTION 055000 - METAL FABRICATIONS

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 framing and supports for countertops.
2. Steel tube reinforcement for low partitions.
3. Steel framing and supports for mechanical and electrical equipment.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Miscellaneous steel trim including steel angles.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:

1. Section 017419 "Construction Waste and Disposal".

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:

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1. Fasteners.
 2. Shop primers.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
1. Steel framing and supports for countertops.
 2. Steel tube reinforcement for low partitions.
 3. Steel framing and supports for mechanical and electrical equipment.
 4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 5. Miscellaneous steel trim including steel angle corner guards.
- C. Delegated Design Submittals: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.
- B. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Research Reports: For post-installed anchors.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 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.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

- 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

- 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 Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.
- D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.
- E. Steel Tubing: ASTM A500/A500M, Grade C cold-formed steel tubing.
- F. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: As indicated.
 - 2. Material: Cold-rolled steel, ASTM A1008/A1008M, structural steel, Grade 33; 0.0677-inch minimum thickness; hot-dip galvanized after fabrication.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless steel fasteners for fastening aluminum or stainless steel.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.

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- D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

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- H. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch

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embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Low Partition Framing Support: 3/8-inch ASTM A36/A36M steel-plate ST50H stud connector designed to support out-of-plane loading of cantilevered partial wall systems that are unsupported at the top track.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich; Pony Wall LGPW36 or comparable product by one of the following:
 - a. The Steel Network; MidWall
 - b. SCAFCO Steel Stud Company; PonyWall
 - c. Approved substitution.
- D. Surface mounted counter brackets: L-shaped bracket fabricated from aluminum T sections designed for supporting deep counter; Model No. EH1824 as manufactured by Rakks Corporation or similar.
 - 1. Size (height by depth by thickness): 24 by 18 by 2 inches.
 - 2. Load capacity per bracket: 450 pounds.
- E. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- F. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

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1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize and prime miscellaneous steel trim.

2.8 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.9 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."

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- E. 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.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

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- B. Anchor supports for overhead doors and overhead grilles securely to, and rigidly brace from, building structure.
- C. Anchor shelf angles securely to existing construction with expansion anchors.
- D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- E. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.
 - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 REPAIRS

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and 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.
 - 2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting." and Section 099123 "Interior Painting."
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

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SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

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. Wood blocking and nailers.
- 2. Plywood backing panels.

B. Related Requirements:

- 1. Section 017419 "Construction Waste and Disposal".
- 2. Section 064116 "Plastic Laminate-Clad Architectural Cabinets".

1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for 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 fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
 - 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

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1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 - 1. Preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Power-driven fasteners.
 - 4. Post-installed anchors.
 - 5. Metal framing anchors.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction,

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and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM 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 feet beyond the centerline of the burners at any time during the test.
 - 1. Treatment shall not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664, and design value adjustment factors shall be calculated according to ASTM D6841. For enclosed roof framing, framing in attic spaces, and where high-temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
- E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat items indicated on Drawings, and the following:
 - 1. Concealed blocking.
 - 2. Plywood backing panels.

2.3 DIMENSION LUMBER

- A. Miscellaneous Framing: Construction or No. 2 grade of any of the following species:
 - 1. Hem-fir (north); NLGA.
 - 2. Douglas fir-larch; WCLIB or WWPA.
 - 3. Douglas fir-south; WWPA.

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4. Hem-fir; WCLIB or WWPA.
5. Douglas fir-larch (north); NLGA.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 1. Blocking.
 2. Nailers.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:
 1. Hem-fir (north); NLGA.
 2. Hem-fir; WCLIB or WWPA.
- C. Concealed Boards: 15 percent maximum moisture content of any of the following species and grades:
 1. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.

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- C. Screws for Fastening to Metal Framing: ASTM C1002 for non-bearing metal framing and ASTM C954 for cold-formed metal framing, length as recommended by screw manufacturer for material being fastened.
- D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 and ICC-ES AC58 as appropriate for the substrate.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.7 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cleveland Steel Specialty Co.
 - 2. KC Metals Products, Inc.
 - 3. Phoenix Metal Products, Inc.
 - 4. Simpson Strong-Tie Co., Inc.
 - 5. USP Structural Connectors.
 - 6. Approved substitution.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.
- D. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
 - 1. Use for exterior locations and where indicated.

2.8 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

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1. Low VOC content.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 2. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.
- H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

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- I. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 - 2. ICC-ES evaluation report for fastener.
- L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILER

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

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SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

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. Plastic-laminate-faced architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
2. Section 123616 "Metal Countertops."
3. Section 123661.19 "Quartz Agglomerate Countertops."

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including panel products, high-pressure decorative laminate, adhesive for bonding plastic laminate and cabinet hardware and accessories.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.

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C. Samples for Initial Selection:

1. Plastic laminates.
2. PVC edge material.
3. Thermoset decorative panels.

D. Samples for Verification:

1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.
2. Thermoset decorative panels, 8 by 10 inches, for each color, pattern, and surface finish, with edge banding on one edge.
3. Corner pieces as follows:
 - a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
 - b. Miter joints for standing trim.
4. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator and installer.
- B. Product Certificates: For the following:
 1. Composite wood and agrifiber products.
 2. Thermoset decorative panels.
 3. High-pressure decorative laminate.
 4. Adhesives.

1.6 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.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockups of typical plastic-laminate cabinets as shown on Drawings.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087111 "Door Hardware (Descriptive Specification)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.

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1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. Grade: Custom.
- C. Type of Construction: Frameless.
- D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
- E. Reveal Dimension: 1/2 inch.
- F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
 1. Manufacturers: Subject to compliance with requirements, provide products as indicated on the drawings – finish schedule.
- G. Laminate Cladding for Exposed Surfaces:
 1. Horizontal Surfaces: Grade HGS.
 2. Postformed Surfaces: Grade HGP.
 3. Vertical Surfaces: Grade VGS.
 4. Edges: Grade HGS where indicated, PVC edge banding, 0.2 inch thick where indicated, matching laminate in color, pattern, and finish.
 5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels, unless otherwise indicated.
- H. Materials for Semiexposed Surfaces:
 1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
 - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.2 inch thick, matching laminate in color, pattern, and finish.
 - b. Edges of Thermoset Decorative Panel Shelves: PVC edge banding, 0.2 inch thick.
 - c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS, unless otherwise indicated.
 2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
 3. Drawer Bottoms: (9) ply Baltic Birch plywood.
- I. Dust Panels: 1/4-inch plywood above compartments and drawers unless located directly under tops.
- J. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

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- K. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- L. 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 on Drawings by laminate manufacturer's designations.

2.2 WOOD MATERIALS (Select from the following)

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: 4 to 9 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 - 1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
 - 3. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
 - 4. Softwood Plywood: DOC PS 1, medium-density overlay.
 - 5. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 110 degrees of opening, self-closing.
 - 1. Basis of Design Product: Subject to compliance with requirements furnish and install Blum, Clip Top Blumotion 120 hinges, or a comparable Approved Equal product acceptable to the Owner and Architect.
- C. Pulls: See Sheet A620 for Drawer Pulls.

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- D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- E. Shelf Rests: BHMA A156.9, B04013; metal, 5 mm, two-pin type with shelf hold-down clip.
- F. Drawer Runner Systems: Concealed runners for wood drawers:
 - 1. Box Drawer Runners, Light to Medium Duty Drawers, 16" wide or less:
 - a. Basis of Design Product: Accuride 3932EC, self-closing full extension slides with up to 150 lb./pr. load rating. Standard finish. or a comparable approved substitution product acceptable to Owner and Architect.
 - 2. Box Drawer Runners, Heavy Duty Drawers, 42" wide or less:
 - a. Basis of Design Product: Accuride 3634EC, self-closing full extension slides with up to 175 lb./pr. load rating. Standard finish. or a comparable approved substitution product acceptable to Owner and Architect.
- G. Door and Drawer Silencers: BHMA A156.16, L03011.
- H. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Chromium Plated: BHMA 613 for brass or bronze base; BHMA 652 for steel base.
 - 2. Satin Stainless Steel: BHMA 613.
- I. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content. Refer to Division 06 Section "Miscellaneous Rough Carpentry.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.
- D. Adhesives: Use low VOC adhesives.
- E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

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2.5 FABRICATION

- A. Fabricate 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.
 - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. Shop-cut openings to maximum extent possible to receive 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 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1. Use filler matching finish of items being installed.

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- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood blocking, or hanging strips. No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish. Use toggle bolts through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semi-exposed surfaces.

END OF SECTION 064116

SECTION 066400 - PLASTIC PANELING

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. Plastic sheet paneling.
- B. Related Requirements:
 - 1. Section 017419 "Construction Waste Management and Disposal."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

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2.2 PLASTIC SHEET PANELING

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319. Panels shall be USDA accepted for incidental food contact.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Marlite, Inc.; Symmetrix SmartSeam FRP or an approved substitution meeting the requirements herein.
 - a. Fiberglass reinforced thermosetting polyester resin panel sheets complying with ASTM D 5319.
 - b. Finishing: BlueSky™ Advanced Finishing System: Spray-applied Sani-coat Sealer covers entire panel including grooves and features water-based coatings and controlled, low-temperature inline curing.
 - c. Dimensions:
 - 1) Nominal Thickness: Not less than 0.09 inch.
 - 2) Width: 48 inches.
 - 3) Length: 48 inches.
 - 4) Tolerance:
 - a) Length and Width: +/-1/8 inches.
 - b) Square: Not to exceed 1/8 inches.
- B. Properties: Resistant to rot, corrosion, denting, peeling, and splintering.
1. Flexural Strength – 0.9×10^4 psi per ASTM D 790.
 2. Flexural Modulus – 6.0×10^6 psi per ASTM D 790.
 3. Tensile Strength – 11.5×10^3 psi per ASTM D 638.
 4. Tensile Modulus – 0.45×10^6 psi per ASTM D 638.
 5. Barcol Hardness (scratch resistance) – 28 per ASTM D 2583.
 6. Izod Impact Strength – 6.0 ft. lbs./in ASTM D 256
 7. Thermal Coefficient of Lineal Expansion – 2.22×10^{-5} in/in/F per ASTM D 696
 8. Water Absorption – 0.15% per ASTM D 570.
 9. Specific Gravity – 1.8 per ASTM D 792.
 10. Cross-cut Adhesion – 0 removed per ASTM D 3359
 11. Mold & Mildew – Pass per ASTM D 3273.
 12. Standard Specification for FRP Wall Panels – per ASTM D 5319
 13. Standard Test Method Surface Burning Characteristics of Building Materials – Class C per ASTM E 84.
- C. Back Surface: Smooth. Imperfections which do not affect functional properties are not cause for rejection.
- D. Front Surface: Smooth with Sani-coat Sealer.
- E. Panel Color and Groove Color: SYM SS100 White Panel and White Grooves.
- F. Finish Gloss Level: High Gloss
- G. Tile Pattern, Groove Direction, Tile Size & Panel Size: Subway Horizontal Direction

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1. 6" x 3" tiles, panel size 4' x 4' nominal

H. Fire Rating: Class C (III) Fire Rating.

2.3 TRIM MOLDING

A. PVC Trim: Thin-wall semi-rigid extruded PVC. Use only as needed.

1. M 350 Inside Corner, 8' length.
2. M 360 Outside Corner, 8' length.
3. Color: White

2.4 ACCESSORIES

A. Adhesive: Either of the following construction adhesives complying with ASTM C 557.

1. Marlite C-551 FRP Adhesive - Water-resistant, non-flammable adhesive. [3.5 gallon can]. Use over porous subwall only, such as unfinished drywall.
2. Marlite C-109 Low VOC Cartridge Adhesive required for interlocking SmartSeam Panels. 28-ounce cartridge.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine sub wall to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.

1. Verify that stud spacing does not exceed 24" on-center.

B. Repair defects prior to installation.

1. Level wall surfaces to panel manufacturer's requirements.
2. Remove protrusions and fill indentations.

3.2 INSTALLATION

A. Comply with manufacturer's recommended procedures and installation sequence.

B. Cut panels to meet supports allowing 1/8" (3 mm) clearance for every 8 feet (2.4m) of panel.

1. Cut and drill with carbide tipped saw blades or drill bits or cut with shears.

C. Apply panels to board substrate, above base, vertically oriented with seams plumb and pattern aligned with adjoining panels.

1. Install panels with manufacturer's recommended gap for panel field and corner joints.

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2. Adhesive trowel and application method to conform to adhesive manufacturer's recommendations.
 3. For interlocking SmartSeam Panels (non-continuous vertical joints, i.e. subway groove configuration), apply Marlite C-109 Low VOC Cartridge adhesive using swirl technique at jagged panel edges.
- D. Apply panel moldings to all panel edges using silicone sealant providing for required clearances.
1. All moldings must provide for a minimum 1/8" (3mm) of panel expansion at joints and edges, to insure proper installation.
 2. Apply sealant to all moldings, channels and joints between the system and different materials to assure watertight installation.

3.3 CLEANING

- A. Remove excess sealant from panels and moldings. Wipe panel down using a damp cloth and mild soap solution or cleaner.
- B. Refer to manufacturer's specific cleaning recommendations Do not use abrasive cleaners.

END OF SECTION 066400

SECTION 072100 - THERMAL INSULATION

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. Glass-fiber blanket insulation.
- B. Related Requirements:
 - 1. Section 017419 "Construction Waste and Disposal".

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Glass-fiber blanket insulation.

1.4 INFORMATIONAL SUBMITTALS

- A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.5 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.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.
- B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.
- C. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
- D. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.
- E. Verify insulation complies with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- F. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
 - 1. Verify adhesives have a VOC content of 70 g/L or less.
 - 2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 GLASS-FIBER BLANKET INSULATION

- A. Verify insulation complies with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Sound Attenuation Batts, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Owens Corning ; PINK NEXT GEN™ FIBERGLAS™ INSULATION. Or an approved substitution meeting the following:
 - a. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.

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- b. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
 - c. Sound Transmission Class: As indicated on drawings to achieve STC per wall assembly type.
- D. Use: Interior walls.

2.3 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
- B. Mechanical fasteners in accordance with insulation manufacturer's written recommendations for mineral wool board insulation
- C. Insulation Clips: in accordance with manufacturer's written recommendations.

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 that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. 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.

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3.3 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer.
 - 1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
 - 2. Press units firmly against inside substrates.
 - 3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- 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 078443 - JOINT FIRESTOPPING

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. Joints in or between fire-resistance-rated constructions.
- B. Related Requirements:
 - 1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.
 - 2. Section 092216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.
 - 3. Section 084113 "Aluminum-Framed Entrances and Storefronts".

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

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- B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."

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2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. ClarkDietrich.
 - c. Hilti, Inc.
 - d. Rockwool International.
 - e. Tremco, Inc.
 - 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Joints in drywall: Provide joint firestopping systems with ratings determined per UL-D-0172.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Trim-Tex, Inc.; 093V or approved substitution.
- D. For aluminum storefront assemblies with one- or two-piece rectangular mullions at least 2 by 4 inches, provide perimeter joint firestopping systems tested in accordance with ASTM E2307 for up to 2-hour fire resistance.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
 - 1. Verify sealant has a VOC content of 250 g/L or less.
- F. Accessories: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, 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: Before installing joint firestopping systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

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3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.
- B. Wall-to-Wall, Joint Firestopping Systems:
 - 1. UL-Classified Systems: WW-D-0074.
 - 2. Assembly Rating: 1 hour.

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3. Nominal Joint Width: 3/4".
4. Movement Capabilities: Class II - percent compression or extension.
5. L-Rating at Ambient: Less than 4 cfm/ft.
6. L-Rating at 400 Deg F: Less than 6 cfm/ft.

C. Head-of-Wall, Fire-Resistive Joint Firestopping Systems:

1. UL-Classified Systems: HW-D-0060.
2. Assembly Rating: 1 hour.
3. Nominal Joint Width: As indicated.
4. Movement Capabilities: Class II - percent compression or extension.
5. L-Rating at Ambient: Less than 1 cfm/ft.
6. L-Rating at 400 Deg F: Less than 2 cfm/ft.

D. Bottom-of-Wall, Joint Firestopping Systems:

1. UL-Classified Systems: BW-D-0068.
2. Assembly Rating: 1 hour.
3. Nominal Joint Width: As indicated.
4. L-Rating at Ambient: Less than 1 cfm/ft.
5. L-Rating at 400 Deg F: Less than 1 cfm/ft.

END OF SECTION 078443

SECTION 079200 - JOINT SEALANTS

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. Silicone joint sealants.
2. Urethane joint sealants.
3. Mildew-resistant joint sealants.
4. Latex joint sealants.

B. Related Requirements:

1. Section 017419 "Construction Waste and Disposal".
2. Section 079219 "Acoustical Joint Sealants"
3. Section 084113 "Aluminum-Framed Entrances and Storefronts" for sealing perimeter joints.
4. Section 092900 "Gypsum Board" for sealing perimeter joints.
5. Section 093013 "Ceramic Tiling".
6. Section 123661.16 "Solid Surfacing Countertops".

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind 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:

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1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.
- C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
 1. Joint-sealant location and designation.
 2. Manufacturer and product name.
 3. Type of substrate material.
 4. Proposed test.
 5. Number of samples required.
- D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- E. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- F. Field-Adhesion-Test Reports: For each sealant application tested.
- G. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
 1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

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1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with masonry substrates.
 4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
 5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
 7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 2. Conduct field tests for each kind of sealant and joint substrate.
 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

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1.8 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content: Verify sealants and sealant primers comply with the following:
 - 1. Architectural sealants have a VOC content of 250 g/L or less.

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2. Sealants and sealant primers for nonporous substrates have a VOC content of 250 g/L or less.
3. Sealants and sealant primers for porous substrates have a VOC content of 775 g/L or less.
4. Product Data: For sealants, indicating VOC content.
5. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - b. Pecora Corporation.
 - c. Sika Corporation; Joint Sealants.

2.3 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Bostik, Inc.
 - c. Pecora Corporation.
 - d. Sherwin-Williams Company (The).
 - e. Sika Corporation; Joint Sealants.
 - f. Tremco Incorporated.

B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Pecora Corporation.
 - c. Polymeric Systems, Inc.

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- d. Sherwin-Williams Company (The).

2.4 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - b. Pecora Corporation.
 - c. Sherwin-Williams Company (The).
 - d. Tremco Incorporated.

2.5 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adfast.
 - b. Alcot Plastics Ltd.
 - c. BASF Corporation.
 - d. Construction Foam Products; a division of Nomaco, Inc.

- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

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- 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. Clean porous joint substrate surfaces 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.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - d. Exterior insulation and finish systems.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- 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

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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 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. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified 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 per Figure 8A in ASTM C1193 unless otherwise indicated.
 - 4. Provide flush joint profile at waterfall edges of solid surfacing according to Figure 8B in ASTM C1193.
 - 5. Provide recessed joint configuration of recess depth and at aluminum storefront systems according to Figure 8C in ASTM C1193.

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- 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. Joint-Sealant Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Joints between plant-precast architectural concrete paving units.
 - c. Tile control and expansion joints.
 - d. Joints between different materials listed above.
 - e. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, M, P, 50, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between plant-precast architectural concrete units.
 - c. Control and expansion joints in unit masonry.
 - d. Joints in exterior insulation and finish systems.
 - e. Joints between metal panels.
 - f. Joints between different materials listed above.
 - g. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 - h. Control and expansion joints in ceilings and other overhead surfaces.
 - i. Other joints as indicated on Drawings.

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2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, S, P, 25, T, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of unit masonry walls and partitions.
 - d. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, S, NS, 25, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Acrylic latex.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

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 acoustical joint sealants.
- B. Related Requirements:
 - 1. Section 017419 "Construction Waste and Disposal".
 - 2. Section 079200 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for non-acoustical applications.

1.3 ACTION SUBMITTALS

- A. Product Data: For each acoustical joint sealant.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of acoustical 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. Acoustical-Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each kind of acoustical joint sealant, for tests performed by a qualified testing agency.
- B. Sample Warranties: For special warranties.

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1.5 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E90.
 - 1. Verify sealant has a VOC content of 250 g/L or less.
 - 2. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. Hilti, Inc.
 - c. Pecora Corporation.
 - d. Tremco Incorporated.
 - e. USG Corporation.
 - 2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

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2.3 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- 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 acoustical 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 acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. 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 ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written

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recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

- C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

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 acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect acoustical 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 acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079219

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

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. Interior standard steel doors and frames.
- B. Related Requirements:
 - 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, and finishes.

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- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 - 7. Details of anchorages, joints, field splices, and connections.
 - 8. Details of accessories.
 - 9. Details of moldings, removable stops, and glazing.
- C. Samples for Initial Selection: For hollow-metal doors and frames with factory-applied color finishes.
- D. Samples for Verification:
 - 1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
 - 2. Fabrication: Prepare Samples approximately 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:
 - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.
- E. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For door inspector.
 - 1. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
- B. Product Test Reports: For each type of thermally rated door assemblies for tests performed by a qualified testing agency indicating compliance with performance requirements.
- C. Field quality control reports.

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1.8 QUALITY ASSURANCE

- A. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAl) certification.
- B. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAl) certification.

1.9 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.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ceco Door; ASSA ABLOY.
 - 2. Curries Company; ASSA ABLOY.
 - 3. Republic Doors and Frames.
 - 4. Rocky Mountain Metals, Inc.
 - 5. Steelcraft; an Allegion brand.
 - 6. Approved substitution.

2.2 PERFORMANCE REQUIREMENTS

- A. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.38 deg Btu/F x h x sq. ft. Insert U-factor when tested according to ASTM C518.

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2.3 INTERIOR STANDARD STEEL DOOR FRAMES

- A. Construct hollow-metal door frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated, unless otherwise indicated, steel sheet, minimum thickness of 0.053 inch
 - d. Edge Construction: Model 2, Seamless.
 - e. Edge Bevel: Bevel lock and hinge edges 1/8 inch in 2 inches.
 - f. Core: Vertical steel stiffener.
 - 1) Fire-Rated Core: Manufacturer's standard core for fire-rated doors where indicated
 - 2. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
 - b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Full profile welded.
 - 3. Exposed Finish: Prime.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - 2. 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 feet.
- B. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

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2.5 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to 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: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
 - 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 as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

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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 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.

3.2 INSTALLATION

- A. 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.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
 - 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 4. Solidly pack mineral-fiber insulation inside frames.
 - 5. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

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- a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

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SECTION 081416 - FLUSH WOOD DOORS

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. Seven-ply flush wood veneer-faced doors for transparent finish.
- B. Related Requirements:
 - 1. Section 081113 "Hollow Metal Doors and Frames".
 - 2. Section 087100 "Door Hardware"

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
 - 1. Door core materials and construction.
 - 2. Door edge construction
 - 3. Door face type and characteristics.
 - 4. Factory- finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:
 - 1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
 - 2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
 - 3. Details of frame for each frame type, including dimensions and profile.
 - 4. Dimensions and locations of blocking for hardware attachment.
 - 5. Dimensions and locations of mortises and holes for hardware.
 - 6. Clearances and undercuts.
 - 7. Requirements for veneer matching.
 - 8. Doors to be factory finished and application requirements.

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- C. Samples for Initial Selection: For factory-finished doors.
- D. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
 - 2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
 - a. Provide Samples for each species of veneer and solid lumber required.
 - b. Provide Samples for each color, texture, and pattern of plastic laminate required.
 - 3. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

- A. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.
- C. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies complies with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
 - 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

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1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain flush wood doors and wood paneling from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.
 - 1. Provide labels from WI certification program indicating that doors comply with requirements of grades specified.
 - 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.
- B. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic

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Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products,"
or are made with no added formaldehyde.

2.3 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Doors:

1. Basis-of-Design Product: Subject to compliance with requirements, provide VT Industries, Inc.; Heritage Collection or an approved substitution meeting the following:
 - a. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty.
 - b. ANSI/WDMA I.S. 1A Grade: Premium.
 - c. Faces: Single-ply wood veneer not less than 1/50 inch thick.
 - 1) Species: White oak.
 - 2) Cut: Plain sliced (flat sliced).
 - 3) Match between Veneer Leaves: Book match.
 - 4) Assembly of Veneer Leaves on Door Faces: Center-balance match.
 - 5) Pair and Set Match: Provide for doors hung in same opening.
 - 6) Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet or more.
 - d. Exposed Vertical and Top Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A.
 - 1) Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
 - 2) Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - 3) Screw-Holding Capability: 550 lbf in accordance with WDMA T.M. 10.
 - e. Core for Non-Fire-Rated Doors:
 - 1) WDMA I.S. 10 structural composite lumber.
 - a) Screw Withdrawal, Door Face: 550 lbf.
 - b) Screw Withdrawal, Vertical Door Edge: 550 lbf.
 - 2) Either glued wood stave or WDMA I.S. 10 structural composite lumber.
2. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.

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1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
1. Locate hardware to comply with DHI-WDHS-3.
 2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
 3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
 4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.

2.5 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 2. Finish faces, all four edges, edges of cutouts, and mortises.
 3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
1. ANSI/WDMA I.S. 1A Grade: Premium.
 2. Finish: ANSI/WDMA I.S. 1A TR-6 Catalyzed Polyurethane.
 3. Staining: As selected by Architect from manufacturer's full range.
 4. Effect: Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.
 5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
 - 1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
 - 2. Anchor frames to anchors or blocking built in or directly attached to substrates.
 - a. Secure with countersunk, concealed fasteners and blind nailing.
 - b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1) For factory-finished items, use filler matching finish of items being installed.
- D. Job-Fitted Doors:
 - 1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
 - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
 - 2. Machine doors for hardware.
 - 3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 4. Clearances:
 - a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
 - b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
 - c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

- A. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

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- C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- D. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

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SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.
- B. Related Requirements:
 - 1. Section 077200 "Roof Accessories" for roof hatches.
 - 2. Section 233300 "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.
- C. Product Schedule: For access doors and frames. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Exposed Flanges for non-public spaces:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. Acudor Products, Inc.
 - b. Babcock-Davis.
 - c. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - d. Larsens Manufacturing Company.
 - e. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 - f. Approved substitution.
2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
 3. Locations: Wall and ceiling.
 4. Door Size: As required for intended access equipment and use.
 5. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory finished for dry locations.
 6. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch, 16 gage, factory finished for wet and humid locations.
 7. Frame Material: Same material, thickness, and finish as door material, thickness, and finish.
 8. Latch and Lock: Cam latch, screwdriver operated for non-public locations, Cam latch, key operated for public locations.
- B. Flush Access Doors with Concealed Flanges for public spaces:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACUDOR Products, Inc.
 - b. Babcock-Davis.
 - c. Karp Associates, Inc.
 - d. Larsens Manufacturing Company.
 - e. Milcor; a division of Hart & Cooley, Inc.
 - f. Approved substitution.
 2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
 3. Locations: Wall and ceiling.
 4. Door Size: As required for intended access equipment and use.
 5. Uncoated Steel Sheet for Door: Nominal 0.060-inch, 16 gage, factory finished for dry locations.
 6. Metallic-Coated Steel Sheet for Door: Nominal 0.064-inch, 16 gage, factory finished for wet and humid locations.
 7. Frame Material: Same material and thickness as door.
 8. Latch and Lock: Cam latch, key operated for public locations.

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

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- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Frame Anchors: Same material as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

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.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
 - 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
 - 1. For recessed doors with plaster infill, provide self-furring expanded-metal lath attached to door panel.
- E. Latch and Lock Hardware:
 - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
 - 2. Keys: Furnish two keys per lock and key all locks alike.

2.4 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil for topcoat.
 - a. Color: As selected by Architect.

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

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- C. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

SECTION 083513.13 - MULTIPANEL FOLDING ALUMINUM-FRAMED GLASS DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Multipanel folding aluminum-framed glass doors.

B. Related Requirements:

1. Section 087100 "Door Hardware" for hardware not specified in this Section.
2. Section 102239.13 "Folding Glass-Panel Partitions for coordinating finish among aluminum fenestration units on the building exterior.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Multipanel folding aluminum-framed glass doors.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for multipanel folding aluminum-framed glass doors.

C. Shop Drawings:

1. Include plans, elevations, sections, and installation details.
2. Indicate dimensions, configuration of panels, and stacking layout.

D. Samples: For each multipanel folding aluminum-framed glass door and for each color specified, 12-inch-long section with factory-applied color finish.

E. Product Schedule: For multipanel folding aluminum-framed glass doors.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturer and testing agency.

B. Product Test Reports: For each multipanel folding aluminum-framed glass door, for tests performed by a qualified testing agency; and for each class and performance grade indicated, tested at AAMA gateway size.

C. Field quality-control reports.

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- D. Sample Warranty: For manufacturer's special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data:

- 1. For multipanel folding aluminum-framed glass doors to include in maintenance manuals. Include finishes, weather stripping, operable panels, and operating hardware.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating multipanel folding aluminum-framed glass doors that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.
- B. Installer Qualifications: An installer acceptable to multipanel folding aluminum-framed glass door manufacturer for installation of units required for this Project.

1.6 WARRANTY

- A. Manufacturer Warranty: Provide Folding Glass Door system manufacturer's standard limited warranty as per manufacturer's published warranty document in force at time of purchase, subject to change, against defects in materials and workmanship.
 - 1. Warranty Period beginning with the earliest of 120 days from Date of Delivery or Date of Substantial Completion:
 - a. Rollers and Insulated Glass Seal Failure: Ten (10) years
 - b. All Other Components Except Screens: Ten (10) years
 - 1) Exception: Five (5) years if NOT installed by manufacturer's specific system approved or certified trained installer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Performance Criteria (Specific or equivalent to lab tested): Performance Sill - Inward Opening.
 - 1. Folding Glass Door Units tested to AAMA/WDMA/CSA 101/1.S.2/A440-17 (NAFS-17):
 - a. Class CW-PG25 - FLD 157-1/2 inch x 102-3/8 inch and Class LC-PG50 - FLD 157-1/2 inch x 102-3/8 inch with 1L3R configuration for inward opening units.

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2. Structural Load Deflection (ASTM E330):
 - a. Design Pressure - Positive: 50 psf
 - b. Design Pressure - Negative: 55 psf
 - c. Uniform Load deflection, L/175: Pass 25 psf
3. Air Infiltration (ASTM E283):
 - a. 0.03 cfm/ft² at a static air pressure difference of 1.57 psf.
 - b. 0.07 cfm/ft² at a static air pressure difference of 6.24 psf.
4. Water Penetration (ASTM E331, ASTM E547):
 - a. No uncontrolled water leakage at a static test pressure of 9 psf.

- B. Thermal Performance (U-factor): NFRC 100 Rated, Certified, and Labeled.
- C. Solar Heat Gain Coefficient (SHGC) + Visible Light Transmission (VT): NFRC 200 Rated, Certified, and Labeled.
- D. Air Leakage: NFRC 400 Rated, Certified, and Labeled.
- E. Condensation Resistance (CR): NFRC 500 Rated, Certified, and Labeled.

2.2 MULTIPANEL FOLDING ALUMINUM-FRAMED GLASS DOORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Nana Wall Systems, Inc.; NW Aluminum 640 or an approved substitution meeting the requirements herein.
- B. Multipanel Folding Aluminum-Framed Glass Doors: Provide extruded-aluminum-framed multipanel folding glass doors, complete with glazing, threshold, flashings, support, and anchorage devices.
 1. Application: Exterior, outward opening.
 2. Stack Storage Configuration: As shown on Drawings.
- C. Frames and Door Panels: Fabricated from aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440. Provide factory-assembled door panels that are reglazable without dismantling panel framing, and factory-assembled frames.
 1. Thermally Improved Construction: Fabricate frames and door panels with an integral, concealed, low-conductance thermal barrier located between exterior and interior surfaces in a manner that eliminates direct metal-to-metal contact.

2.3 GLAZING

- A. Glass and Glazing: Manufacturer's standard glazing system that produces weathertight seal.

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1. Glass: ASTM C1036, Type 1, q3; Category II safety glass complying with testing requirements in 16 CFR 1201.
2. Tint: Clear.
3. Insulating-Glass Units: ASTM E2190.
 - a. Filling: Fill space between glass lites with argon.
 - b. Lites: Two.
 - c. Low-E Coating: Manufacturer's standard.

2.4 HARDWARE

- A. Provide manufacturer's standard hardware, fabricated from a corrosion-resistant material compatible with door panels and other components, and complying with AAMA 907. Provide hardware designed to smoothly operate, tightly close, and securely lock multipanel folding aluminum-framed glass doors. Size hardware to accommodate panel weights and dimensions. Provide full-perimeter weatherstripping for each door panel.
- B. Panel Support System: Provide panel support system designed for size, weight, and performance requirements of multipanel folding aluminum-framed glass doors indicated. Provide carriers with sealed ball bearings.
 1. Bottom Supported: Provide carrier system designed to roll on track within threshold, with overhead wheeled guide that engages upper track.
 - a. Provide High Performance Sill.
 2. Adjustment: Provide panel support system capable of being adjusted for smooth operation and clearances without needing to remove panels from tracks.
 3. Threshold Configuration: Extruded-aluminum, thermally broken, threshold with recessed flush profile.
 - a. Aluminum Finish: Clear anodized.
- C. Panel Hinges: Stainless steel, multileaf hinge with painted finish to match exterior. Provide integral hangers and guides for hinges that engage panel support system.
- D. Locking System:
 1. Primary Entrance Panel: Provide manufacturer's standard keyed multipoint locking device, with lever handles on the interior and exterior that operate dead bolt and concealed top and bottom rods.
 2. Panel Pairs: Provide manufacturer's standard handles and two-point locking device that operates concealed top and bottom rods at each panel pair.
 3. Trim Design: As selected from manufacturer's full range.
 - a. Finish: As selected from manufacturer's full range of finishes.
 4. Cylinders: As specified in Section 087100 "Door Hardware."

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2.5 ACCESSORIES

- A. Trim: Provide interior and exterior casings, jamb extensions, and other components in material and finish to match door frames.
- B. Fasteners: Noncorrosive and compatible with door members, trim, hardware, anchors, and other components.
 - 1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.
- C. Anchors, Clips, and Accessories: Provide anchors, clips, and accessories of aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron for multipanel folding aluminum-framed glass doors, complying with ASTM B456 or ASTM B633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
 - 1. Windborne-Debris Resistance: Provide anchors of same design used in windborne-debris resistance testing.

2.6 FABRICATION

- A. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- B. Factory-Glazed Fabrication: Glaze sliding aluminum-framed glass doors in the factory.

2.7 GENERAL FINISH REQUIREMENTS

- A. 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.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of Work.

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- B. Verify rough opening dimensions, levelness of threshold substrate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight hinged-door installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing multipanel folding aluminum-framed glass doors, hardware, accessories, and other components.
- B. Install multipanel folding aluminum-framed glass doors level, plumb, square, true to line; without distortion, warp, or rack of frames and panels, and without impeding thermal movement; anchored securely in place to structural support; and in proper relation to wall flashing, vapor retarders, air barriers, water/weather barriers, and other adjacent construction.
- C. Set threshold members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Test and inspect installed multipanel folding aluminum-framed glass doors as follows:
 - 1. Testing Methodology: Test multipanel folding aluminum-framed glass doors for air infiltration and water resistance in accordance with AAMA 502.
 - 2. Air-Infiltration Testing:
 - a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
 - b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
 - 3. Water-Resistance Testing:

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- a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
 - b. Allowable Water Infiltration: No water penetration.
4. Testing Extent: Three multipanel folding aluminum-framed glass doors of each type as selected by Architect and a qualified independent testing and inspecting agency. Conduct tests after perimeter sealants have cured.
5. Test Reports: Prepared in accordance with AAMA 502.
- C. Multipanel folding aluminum-framed glass door will be considered defective if it does not pass tests and inspections.

3.4 ADJUSTING

- A. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.
- B. Adjust hardware and operable panels to function smoothly, and lubricate as recommended by manufacturer.

3.5 CLEANING

- A. Clean exposed surfaces immediately after installation. Avoid damaging protective coatings and finishes. Remove nonpermanent labels, excess sealants, glazing materials, dirt, and other substances.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

3.6 PROTECTION

- A. Protect multipanel folding aluminum-framed glass door surfaces from contact with contaminating substances resulting from construction operations. Remove contaminants immediately according to manufacturer's written instructions.
- B. Refinish or replace folding aluminum-framed glass doors with damaged finishes.

END OF SECTION 083513.13

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SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hardware for Swinging Doors
2. Hardware for fire-rated doors.
3. Locks & cylinders for doors with balance of hardware specified in other sections.
4. Protection Plates and Gasketing.

B. Related Requirements:

1. Section 081113 "Hollow Metal Frames".
2. Section 081416 "Flush Wood Doors".

1.2 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ANSI/BHMA Certified product Standards – A156 Series.
- C. DHI (H&S) - Sequence and Format for the Hardware Schedule 2019.
- D. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.
- G. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2022.
- H. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.
- I. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.
- J. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

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1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
- B. Sequence installation to ensure facility services connections are achieved in an orderly and expeditious manner.
 - 1. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 2. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware for wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 - 3. Review and finalize construction schedule and verify availability of materials.
 - 4. Review the required inspecting, testing, commissioning, and demonstration procedures.
- C. Keying Requirements Meeting:
 - 1. Upon creation of the purchase order of BEST Keys and Cores, hardware supplier is to coordinate a meeting with the BEST Key System Specialist, Owners Representatives and Architect.
 - 2. Keying Requirements Meeting Agenda:
 - a. Establish keying requirements.
 - b. Verify locksets and locking hardware are functionally correct for project requirements.
 - c. Verify that keying and programming complies with project requirements.
 - d. Establish keying submittal schedule and update requirements.
 - 3. BEST Key System Specialist to incorporate "Keying Requirements Meeting" decisions into keying submittal for owner review of door hardware keying system.
 - 4. After approval of keying submittal, deliver established keying requirements to manufacturer for incorporation into project.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
- C. Shop Drawings - Door Hardware Schedule: A detailed listing that includes each item of hardware to be installed on each door.

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1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
 2. Comply with DHI (H&S) using door numbering scheme and hardware set numbers as indicated in Contract Documents.
 - a. Submit in vertical format.
 3. Include complete description for each door listed.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- E. Installer's qualification statement. Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.
- F. Supplier's qualification statement. Company with certified Architectural Hardware Consultant (AHC) to assist in work of this section.
- G. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- H. Keying Schedule:
 1. Submit one (1) electronic copy of Keying Schedule in compliance with requirements established during Keying Requirements Meeting for distribution to project team unless otherwise indicated.
- I. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- J. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- K. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
 1. See Section 016000 - Product Requirements, for additional provisions.
- 1.5 QUALITY ASSURANCE
- A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
- B. Sequence installation to ensure facility services connections are achieved in an orderly and expeditious manner.
- C. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

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1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide manufacturer warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.
 - 1. Closers: 25 years, minimum.
 - 2. Exit Devices: Three years, minimum.
 - 3. Locksets and Cylinders: Three years, minimum.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.
 - 1. Permanent cylinders, cores, and keys to be installed by Owner.

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- D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HINGES

- A. Manufacturers: Conventional butt hinges.

- 1. BEST (Stanley)

- B. Properties:

- 1. Butt Hinges: As applicable to each item specified.

- a. Standard Weight Hinges: Minimum of two (2) permanently lubricated non-detachable bearings.
- b. Heavy Weight Hinges: Minimum of four (4) permanently lubricated bearings on heavy weight hinges.
- c. Template screw hole locations.
- d. Bearing assembly installed after plating.
- e. Bearings: Exposed fully hardened bearings.
- f. Bearing Shells: Shapes consistent with barrels.
- g. Pins: Easily seated, non-rising pins.

- 1) Fully plate hinge pins.
- 2) Non-Removable Pins: Slotted stainless steel screws.

- h. UL 10C listed for fire-resistance-rated doors.

- C. Sizes: See Door Hardware Schedule.

- 1. Hinge Widths: As required to clear surrounding trim.
- 2. Sufficient size to allow 180 degree swing of door.

- D. Finishes: See Door Hardware Schedule.

- 1. Fully polish hinges, front, back, and barrel.

- E. Grades:

- 1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.

- F. Material: Base metal as indicated for each item by BHMA material and finish designation.

- G. Types:

- 1. Butt Hinges: Include full mortise hinges.

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H. Options: As applicable to each item specified.

I. Quantities:

1. Butt Hinges: Three (3) hinges per leaves up to 90 inches (2286 mm) in height. Add one (1) for each additional 30 inches (762 mm) in height or fraction thereof.
 - a. Hinge weight and size unless otherwise indicated in hardware sets:
2. For doors up to 36 inches (914 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.134 inch (3.4 mm) and a minimum of 4-1/2 inches (114 mm) in height.
3. For doors from 36 inches (914 mm) wide up to 48 inches (1219 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.180 inch (4.6 mm) and a minimum of 5 inches (127 mm) in height.
4. For doors greater than 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.180 inch (4.6 mm) and a minimum of 5 inches (127 mm) in height.

2.3 CYLINDRICAL LOCKS

A. Manufacturers:

1. BEST (BE) – 9K3 Series.

B. Properties:

1. Mechanical Locks: Manufacturer's standard.
 - a. Door Thickness Coordination Fitting 1-3/4 inch (44 mm) to 2-1/4 inch (57 mm) thick doors.
 - b. Latch: Solid, one-piece, anti-friction, self-lubricating stainless steel.
 - c. Latchbolt Throw: 5/8 inch minimum.
 - d. Auxiliary Deadlatch: One piece stainless steel, permanently lubricated.
 - e. Backset: 2-3/4 inch.
 - f. Lever Trim:
 - 1) Independent spring mechanism for each lever.
 - 2) Trim to be self-aligning and thru-bolted.
 - 3) Handles: Made of forged or cast brass, bronze, or stainless steel construction. Levers that contain a hollow cavity are not acceptable.

C. Finishes: See Door Hardware Schedule

1. Core Faces: Match finish of lockset

D. Grades: Grade 1

2.4 EXIT DEVICES

A. Manufacturers:

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1. Precision (PR) APEX 2000 Series.

B. Properties:

1. Touchpads: 'T' style metal touchpads and rail assemblies with matching chassis covers end caps.
2. Latch Bolts: Stainless steel deadlocking with 3/4 inch (19 mm) projection using latch bolt.
3. Lever Design: Match project standard lockset trims.
4. Cylinder: Include where cylinder dogging or locking trim is indicated.
5. Strike as recommended by manufacturer for application indicated.
6. Sound dampening on touch bar.
7. Dogging:
 - a. Non-Fire-Resistance-Rated Devices: cylinder dogging.
 - b. Fire-Resistance-Rated Devices: Manual dogging not permitted.
8. Touch bar assembly on wide style exit devices to have a 1/4 inch (6.3 mm) clearance to allow for vision frames.
9. All exposed exit device components to be of architectural metals and "true" architectural finishes.
10. Handing: Field-reversible.
11. Fasteners on Back Side of Device Channel: Concealed - exposed fasteners not allowed.
12. Vertical Latch Assemblies' Operation: Gravity, without use of springs.

C. Grades: Complying with BHMA A156.3, Grade 1.

1. Provide exit devices tested and certified by UL or by a recognized independent laboratory for mechanical operational testing to 10 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.

2.5 LOCK CYLINDERS

A. Manufacturers:

1. BEST, SFIC

B. Properties:

1. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
 - a. Provide cylinders from same manufacturer as locking device.
 - b. Provide cams and/or tailpieces as required for locking devices.
 - c. Provide cylinders with appropriate format interchangeable cores where indicated.

C. Grades:

1. Standard Security Cylinders: Comply with BHMA A156.5.

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- D. Types: As applicable to each item specified.

2.6 Keys and Cores

- A. Manufacturers:

- 1. BEST (BE)

- B. Properties: Complying with guidelines of BHMA A156.28.

- 1. Provide small format interchangeable core.
- 2. Provide keys and cores as required for use with locks and devices indicated in hardware sets.
- 3. Provide keying information in compliance with DHI standards.
- 4. Keying Schedule: Arrange for a keying meeting, with Architect, Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying complies with project requirements.
- 5. Keying: Master keyed by Facility.
- 6. Include construction keying and cores for all exterior doors during construction and supply control keying with removable core cylinders.
- 7. Supply keys in following quantities:
 - a. Master Keys: 4 each.
 - b. Construction Master Keys: 6 each.
 - c. Construction Keys: 15 each.
 - d. Construction Control Keys: 2 each.
 - e. Control Keys if New System: 2 each.
- 8. Provide key collection envelopes, receipt cards, and index cards in quantity suitable to manage number of keys.
- 9. Deliver keys with identifying tags to Owner by security shipment direct from manufacturer.
- 10. Permanent Keys and Cores: Stamped with applicable key marking for identification. Do not include actual key cuts within visual key control marks or codes. Stamp permanent keys "Do Not Duplicate."
- 11. Include installation of permanent cores and return construction cores to hardware supplier. Construction cores and keys to remain property of hardware supplier.

- C. Patented Cormax Keying.

2.7 DOOR PULLS AND PUSH PLATES

- A. Manufacturers:

- 1. Trimco (TR)

- B. Door Pulls and Push Plates: Comply with BHMA A156.6.

- 1. Pull Type: Offset
- 2. Pull Plate: Flat, with square corners with C shape bar pull.

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3. Push Plate Type: Flat, with square corners, unless otherwise indicated.
 - a. Edges: Beveled, unless otherwise indicated.
4. Material: Aluminum, unless otherwise indicated.

2.8 CLOSERS

A. Manufacturers; Surface Mounted:

1. Best EHD9000 Series

B. Rack and Pinion Cast Iron Surface Closers (Extra Heavy Duty)

1. Provide Full Rack and Pinion type closer constructed of one-piece cast iron, or equal, to exceed the ANSI/BHMA A156.4 Grade 1 requirements.
2. Provide closers tested and approved for UL10C for positive pressure; UL228 & CAN/ULC-S133.
3. Provide closers that conform to ANSI/ICC A117.1 and ADA requirements for barrier-free accessibility.
4. Closer shall be available with heavy-duty arms and knuckles/elbows.
5. Closer shall have maximum 2 1/4 inch case projection with non-ferrous cover.

C. Closer cover to be:

1. Plastic (default)

D. Closer cover finish to be:

1. Painted

E. Provide closers with all-weather hydraulic fluid.

F. Provide closers with separate adjusting valves for closing and latching speeds, as well as advanced variable backcheck and delayed action.

1. Provide closers with Delayed Action and/or Advanced Variable Backcheck where noted in hardware sets.
2. Provide closers with backcheck positioning & DA valve.

G. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions.

H. Mount closers on non-public side of door and stair side of stair doors, unless otherwise noted in hardware sets.

I. Closers shall be non-handed and multi-sized as noted in hardware sets.

J. When specific sized closers are required provide: Size 1 through 6 - +50% power over size 6 to meet barrier-free ADA and PT4C requirements.

K. Provide closers with separate adjusting valves for closing and latching speeds, as well as backcheck and delayed action.

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L. Installation:

1. Mounting: Includes surface mounted installations.
2. Mount closers on non-public side of door and stair side of stair doors unless otherwise noted in hardware sets.
3. At outswinging exterior doors, mount closer on interior side of door.
4. Provide adapter plates, shim spacers, and blade stop spacers as required by frame and door conditions.
5. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.

2.9 PROTECTION PLATES

A. Manufacturers:

1. Trimco

B. Properties:

1. Plates:

- a. Kick Plates: Provide along bottom edge of push side of every wood door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.

- 1) Size: 10 inches (254 mm) high by 2 inch (51 mm) less door width (LDW) on push side of door except as noters otherwise in the hardware set.

- b. Edges: Beveled, on four (4) unless otherwise indicated.

C. Grades: Comply with BHMA A156.6.

D. Material: As indicated for each item by BHMA material and finish designation.

1. Metal Properties: Stainless steel.

- a. Metal, Standard Duty: Thickness 0.050 inch (1.27 mm), minimum.

E. Installation:

1. Fasteners: Countersunk screw fasteners

2.10 STOPS AND HOLDERS

A. Manufacturers:

1. Trimco

B. General: Provide overhead stop/holder when wall or floor stop is not feasible.

C. Grades:

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1. Door Holders, Wall Bumpers, and Floor Stops: Comply with BHMA A156.16 and Resilient Material Retention Test as described in this standard.
- D. Material: Base metal as indicated for each item by BHMA material and finish designation.
- E. Installation:
 1. Non-Masonry Walls: Confirm adequate wall reinforcement has been installed to allow lasting installation of wall bumpers.

2.11 GASKETING

- A. Manufacturers:
 1. National Guard Products
- B. Properties:
 1. Weatherstripping Air Leakage: Resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
 2. Adhesive-Backed Perimeter Gasketing: Silicone gasket material applied to frame with self-adhesive.
- C. Grades: Comply with BHMA A156.22.

2.12 ASTRAGALS

- A. Manufacturers:
 1. National Guard Products.
- B. Astragals: Comply with BHMA A156.22.
 1. Provide adhesive edge mounted astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.

2.13 MISCELLANEOUS ITEMS

- A. Manufacturers:
- B. Properties:
 1. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
 - a. Single Door: Provide three on strike jamb of frame.
 - b. Pair of Doors: Provide two on head of frame, one for each door at latch side.
 - c. Material: Rubber, gray color.

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2. Silencers are not specified in hardware sets. To be supplied with HM frame supplier.

2.14 FINISHES

- A. Finishes: Identified in Hardware Sets.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.
- B. Correct all defects prior to proceeding with installation.
- C. Verify that electric power is available to power operated devices and of correct characteristics.

3.2 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Install hardware using the manufacturer's fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.
- C. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.
- D. Install hardware for smoke and draft control doors in accordance with NFPA 105.
- E. Use templates provided by hardware item manufacturer.
- F. Do not install surface mounted items until application of finishes to substrate are fully completed.
- G. Wash down masonry walls and complete painting or staining of doors and frames.
- H. Complete finish flooring prior to installation of thresholds.
- I. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list, unless noted otherwise in Door Hardware Schedule or on drawings.
 1. Mounting heights in compliance with ADA Standards:
 - a. Locksets: 40-5/16 inch (1024 mm).
 - b. Push Plates/Pull Bars: 42 inch (1067 mm).
 - c. Deadlocks (Deadbolts): 48 inch (1219 mm).

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d. Exit Devices: 40-5/16 inch (1024 mm).

- J. Include in installation for existing doors and frames any necessary field modification and field preparation of doors and frames for new hardware. Provide necessary fillers, reinforcements, and fasteners for mounting new hardware and to cover existing door and frame preparations.

3.3 PROTECTION

- A. Protect finished Work under provisions of Section 017000 - Execution and Closeout Requirements.
- B. Do not permit adjacent work to damage hardware or finish.

3.4 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.5 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
 - 1. Quantities listed are for each pair of doors, or for each single door.
 - 2. The supplier is responsible for handing and sizing all products.
 - 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

MANUFACTURER LIST

Code	Name
BE	BEST ACCESS SYSTEMS
DM	DORMA DOOR CONTROLS
NA	NATIONAL GUARD
OT	BY OTHERS
PR	BEST PRECISION EXIT DEVICES
ST	BEST HINGES AND SLIDING
TR	TRIMCO

OPTION LIST

Code	Description
B4E	BEVELED 4 EDGES

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FL FIRE EXIT HARDWARE
LBR LESS BOTTOM ROD**HARDWARE SETS****Set #1.0**

Doors: 401

1	Door, Frame & Hardware	By NANAWALL System Supplier		OT
1	Rim Cylinder	12E-72 PATD	626	BE

NOTE:

* Verify cylinder type and quantity required to secure opening.

Set #2.0

Doors: 400T

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Rim Exit (classroom, rated)	2108 x 4908A	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer (parallel arm)	EHD9016 AF90P	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E CSK	630	TR
1	Wall Bumper	1270CV	626	TR

Set #3.0

Doors: 400D

3	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Rim Exit (classroom, rated)	FL 2108 X 4908A	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer (parallel arm)	EHD9016 AF90P	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E CSK	630	TR
1	Wall Bumper	1270CV	626	TR
1	Perimeter Seal	5050 C (head & jambs)		NA

Set #4.0

Doors: 400U

3	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Lockset (storeroom)	9K3-7D15D PATD	626	BE
1	Wall Bumper	1270CV	626	TR
1	Perimeter Seal	5050 C (head & jambs)		NA

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Doors: 406

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Lockset (storeroom)	9K3-7D15D PATD	626	BE
1	Closer (regular, delayed arm)	EHD9016 AF90 DA AVB	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E CSK	630	TR
1	Wall Bumper	1270CV	626	TR
1	Perimeter Seal	5050 C (head & jambs)		NA

Set #6.0

Doors: 403

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Lockset (storeroom)	9K3-7D15D PATD	626	BE
1	Overhead Stop	902 S	689	DM
1	Perimeter Seal	5050 C (head & jambs)		NA

Set #7.0

Doors: 404

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Push/Pull Plate	1895-4B	630	TR
1	Closer (regular arm)	EHD9016 AF90	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E CSK	630	TR
1	Wall Bumper	1270CV	626	TR

Set #8.0

Doors: 402

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Push/Pull Plate	1895-4B	630	TR
1	Closer (regular arm)	EHD9016 AF90	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E CSK	630	TR
1	Dome Stop	1211	626	TR

Set #9.0

Doors: 400

6	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
2	CVR Exit (wd, clsrn, lbr)	2708 X 4908A LBR	630	PR
2	Rim Cylinder	12E-72 PATD	626	BE
2	Electro-Magnetic HO Closer	8916 EMR PT 24V FC	689	DM
2	Kick Plate	K0050 10" x 2" LDW B4E CSK	630	TR
2	Dome Stops (recommended)	1211 (verify unobtrusive location)	625	TR
1	Perimeter Seal	5050 C (head & jambs)		NA

* Verify if connection to the fire alarm system is desired since doors are not fire rated.

* Provide power to the opening for the closer/hold open function.

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DOOR / HARDWARE SET SCHEDULE

<u>Opening</u>	<u>Hdw Set</u>	<u>Opening</u>	<u>Hdw Set</u>	<u>Opening</u>	<u>Hdw Set</u>
400	9.0	400U	4.0	403	6.0
400D	3.0	401	1.0	404	7.0
400T	2.0	402	8.0	406	5.0

END OF SECTION 0871000

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SECTION 092216 - NON-STRUCTURAL METAL FRAMING

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. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

B. Related Requirements:

1. Section 017419 "Construction Waste and Disposal".
2. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.
3. Section 072100 "Thermal Insulation".
4. Section 092900 "Gypsum Board".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For equivalent gauge steel studs and runners and firestop tracks, submit evaluation reports certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 accreditation criteria for inspection agencies.

1.5 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified in accordance with the product-certification program of the Steel Framing Industry Association (SFIA) or a similar organization that provides a verifiable code-compliance program.

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1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.

2.2 FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent, unless otherwise indicated. Framing Members, General: Comply with ASTM C754 for conditions indicated.
- B. Framing Members, General: Comply with AISI S220 for conditions indicated.
 - 1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: AISI S220; ASTM A 653/A 653M, G40; or coating with equivalent corrosion resistance, hot-dip galvanized unless otherwise indicated. Galvannealed products are unacceptable.
 - a. Coating shall demonstrate equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- C. Studs and Tracks: ASTM C645. Use either conventional steel studs and tracks or equivalent gauge, high-strength steel studs and tracks.
 - 1. Steel Studs and Tracks:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich; ProSTUD Drywall Framing or a comparable product by one of the following:

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- 1) CEMCO; California Expanded Metal Products Co.
- 2) MarinoWARE.
- 3) MBA Building Supplies.
- 4) Approved substitution.

- a. Minimum Base-Steel Thickness: 0.0269 inch.
- b. Depth: As indicated on Drawings.
- c.
- d. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: AISI S220 top runner with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Double-Track System: AISI S220 top outer tracks, inside track with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
3. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

a. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich ; MaxTrak Slotted Deflection Track. or a comparable product by one of the following:

- 1) CEMCO; California Expanded Metal Products Co.
- 2) MBA Building Supplies.
- 3) MarinoWARE.
- 4) Approved substitution.

E. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich; MaxTrak or a comparable product by one of the following:

- a. CEMCO; California Expanded Metal Products Co.
- b. Fire Trak Corp.
- c. MarinoWARE.
- d. Approved substitution.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

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- B. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- C. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
 - 1. Depth: 1-1/2 inches.
- E. Furring Channels (Furring Members):
 - 1. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch deep.
 - a. Minimum Base-Steel Thickness: 0.0296 inch.
- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Ceiling & Wall Solutions.
 - b. Rockfon (Rockwool International).
 - c. USG Corporation.

2.4 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. Isolation Strip at Exterior Walls:
 - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, 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.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
 - 2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
 - 3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

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2. 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.
 - 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.
3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 1. Hangers: 48 inches o.c.
 2. Carrying Channels (Main Runners): 48 inches o.c.
 3. Furring Channels (Furring Members): 24 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.

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2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

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.
2. Tile backing panels.
3. Texture finishes.

B. Related Requirements:

1. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
2. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
3. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum board, Type X.
2. Glass-mat, water-resistant backing board.
3. Joint treatment materials.
4. Sound-attenuation blankets.
5. Acoustical sealant.
6. Textured finishes.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

C. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

D. Samples for Initial Selection: For each type of trim accessory and textured finish indicated.

E. Samples for Verification: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

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1.3 MOCKUPS

- A. Build mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 - b. Each texture finish indicated.
 - 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
 - 3. Simulate finished lighting conditions for review of mockups.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 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.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board 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, and 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.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

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2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.3 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.4 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C1396/C1396M.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide USG Corporation; USG Sheetrock® Brand EcoSmart Panels Firecode® X or a comparable product by one of the following:
 - a. CertainTeed Gypsum.
 - b. Georgia-Pacific Gypsum LLC.
 - c. National Gypsum Company.
 - d. Approved substitution.
 - 2. Thickness: 5/8 inch.
 - 3. Long Edges: Tapered.

2.5 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide USG Corporation ; USG Durock™ Glass-Mat Tile Backerboard. or a comparable product by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Georgia-Pacific Gypsum LLC.
 - c. Gold Bond Building Products, LLC provided by National Gypsum Company.
 - 2. Core: 5/8 inch, Type X.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

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2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. Expansion (control) joint.

2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
- D. Joint Compound for Tile Backing Panels:
 - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.8 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

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- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."
- F. 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, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- 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.

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- E. Form control and expansion 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.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- 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.
- H. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: As indicated on Drawings.
 - 2. Abuse-Resistant Type: Apparatus Bay/Decon Laundry at wall types P4/P5 in this area.
 - 3. Glass-Mat Interior Type: As indicated on Drawings.
- B. 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.
 - 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:

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1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
2. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints in accordance with ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners.
 2. LC-Bead: Use at exposed panel edges.
 3. U-Bead: Use at exposed panel edges where indicated.

3.5 FINISHING OF GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and in accordance with ASTM C840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Panels that are substrate for tile.
 3. 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 099123 "Interior Painting."
 4. Level 5: Community Room Walls to receive paint.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

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- E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and 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

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Thresholds.
3. Waterproof membranes.
4. Crack isolation membranes.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Section 092900 "Gypsum Board" for cementitious backer units and glass-mat, water-resistant backer board.

1.2 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Face Size: Actual tile size, excluding spacer lugs.
- C. Module Size: Actual tile size plus joint width indicated.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification:

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1. Full-size units of each type and composition of tile and for each color and finish required.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 36 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory for each color and finish required.
4. Metal edge strips in 6-inch lengths.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product.
- D. Product Test Reports: For tile-setting and -grouting products.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of shower receptors and large format tile.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

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- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type from single source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
 - 2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 - 1. Marble thresholds.
 - 2. Waterproof membrane.
 - 3. Crack isolation membrane.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.

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- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

2.3 TILE PRODUCTS

A. Porcelain Tile Type T1:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Tilebar; Angela Harris Flatiron or approved substitution meeting the following requirements:
 - a. Module Size: Nominal 24 inches by 48 inches.
 - b. Thickness: 10.3 mm.
 - c. Face: Manufacturer's standard, unless indicated otherwise.
 - d. Finish: Matte.
 - e. Tile Color: Graphite.
 - f. Grout Color: Custom Building Products; TBD, Epoxy.
 - g. Grout Joint Widths: 3/16 inches.
 - h. Installation Method: As selected by Architect.

B. Porcelain Tile Type T2:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Tilebar; Angela Harris Flatiron or approved substitution meeting the following requirements:
 - a. Module Size: Nominal 16 inches by 47 inches.
 - b. Thickness: 10.3 mm.
 - c. Face: Manufacturer's standard, unless indicated otherwise.
 - d. Finish: Matte.
 - e. Tile Color: Aquamarine.
 - f. Grout Color: Custom Building Products; TBD, Epoxy.
 - g. Grout Joint Widths: 3/16 inches.
 - h. Installation Method: As selected by Architect.

C. Porcelain Tile Type T3:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Emser Tile; Synergy or approved substitution meeting the following requirements:

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- a. Module Size: Nominal 24 inches by 48 inches.
- b. Thickness: 10.9 mm.
- c. Face: Manufacturer's standard, unless indicated otherwise.
- d. Finish: Satin.
- e. Tile Color: White Plaster.
- f. Grout Color: Custom Building Products; TBD, Epoxy.
- g. Grout Joint Widths: 3/16 inches.
- h. Installation Method: As selected by Architect.

D. Ceramic Tile T4:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Studios; Aquarelle or approved substitution meeting the following requirements:
 - a. Module Size: Nominal 3 inches by 12 inches.
 - b. Thickness: 10 mm.
 - c. Face: Manufacturer's standard, unless indicated otherwise.
 - d. Finish: Gloss.
 - e. Tile Color: Titanium Blue.
 - f. Grout Color: Custom Building Products; TBD.
 - g. Grout Joint Widths: Approx. 1/16 inches.
 - h. Installation Method: As selected by Architect.

E. Ceramic Tile T5:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Studios; Oxida or approved substitution meeting the following requirements:
 - a. Module Size: Nominal 3 inches by 12 inches.
 - b. Thickness: 10 mm.
 - c. Face: Manufacturer's standard, unless indicated otherwise.
 - d. Finish: Gloss.
 - e. Tile Color: Green.
 - f. Grout Color: Custom Building Products; TBD.
 - g. Grout Joint Widths: Approx. 3/16 inches.
 - h. Installation Method: As selected by Architect.

F. Ceramic Tile T6:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Florida Tile; Storied or approved substitution meeting the following requirements:
 - a. Module Size: Nominal 2 inches by 10 inches.
 - b. Thickness: 7.5 mm.
 - c. Face: Manufacturer's standard, unless indicated otherwise.
 - d. Finish: Gloss.
 - e. Tile Color: Cotton White.
 - f. Grout Color: Custom Building Products; TBD.

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- g. Grout Joint Widths: Approx. 3/16 inches.
- h. Installation Method: As selected by Architect.

G. Porcelain Tile Type T7:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Studios; WOW Pottery or approved substitution meeting the following requirements:
 - a. Module Size: Nominal 2 inches by 6 inches.
 - b. Thickness: 10 mm.
 - c. Face: Manufacturer's standard, unless indicated otherwise.
 - d. Finish: Matte.
 - e. Tile Color: Natural.
 - f. Grout Color: Custom Building Products; TBD.
 - g. Grout Joint Widths: Approx. 3/16 inches.
 - h. Installation Method: As selected by Architect.

H. Porcelain Tile Type T8:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Studios; WOW Pottery or approved substitution meeting the following requirements:
 - a. Module Size: Nominal 2 inches by 6 inches.
 - b. Thickness: 10 mm.
 - c. Face: Manufacturer's standard, unless indicated otherwise.
 - d. Finish: Matte.
 - e. Tile Color: Cosmic Natural.
 - f. Grout Color: Custom Building Products; TBD.
 - g. Grout Joint Widths: Approx. 3/16 inches.
 - h. Installation Method: As selected by Architect.

I. Porcelain Tile Type T9:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Studios; WOW Pottery or approved substitution meeting the following requirements:
 - a. Module Size: Nominal 2 inches by 6 inches.
 - b. Thickness: 10 mm.
 - c. Face: Manufacturer's standard, unless indicated otherwise.
 - d. Finish: Matte.
 - e. Tile Color: Grey.
 - f. Grout Color: Custom Building Products; TBD.
 - g. Grout Joint Widths: Approx. 3/16 inches.
 - h. Installation Method: As selected by Architect.

J. Porcelain Tile Type T10:

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1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Studios; WOW Pottery or approved substitution meeting the following requirements:

- a. Module Size: Nominal 2 inches by 6 inches.
- b. Thickness: 10 mm.
- c. Face: Manufacturer's standard, unless indicated otherwise.
- d. Finish: Matte.
- e. Tile Color: Gold.
- f. Grout Color: Custom Building Products; TBD.
- g. Grout Joint Widths: Approx. 3/16 inches.
- h. Installation Method: As selected by Architect.

- K. Accessories: Provide accessories of type and size indicated, suitable for installing by same method as used for adjoining wall tile.

1. Metal cove base: Basis-Of-Design: Schluter; DILEX-AHK.
2. Edge Trim: Basis-Of-Design: Schluter; FINEC.

2.4 WATERPROOF MEMBRANES

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

- B. Waterproof Membrane, Chlorinated Polyethylene Sheet: polypropylene fleece laminated on both sides.

1. Basis-Of-Design Manufacturer: Subject to compliance with requirements, provide Schluter Systems L.P; KERDI or approved substitution.

- a. Nominal Thickness: 0.008 inch.

2.5 CRACK ISOLATION MEMBRANES

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

- B. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch nominal thickness.

1. Basis-Of-Design Manufacturer: Subject to compliance with requirements, provide Schluter Systems L.P; DITRA or approved substitution.

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2.6 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02. (For Large-Format tile)
 - 1. Cleavage Membrane: Installer's option of material that complies with ANSI A108.02, paragraph 3.8.
 - 2. Expanded Metal Lath: Diamond-mesh lath complying with ASTM C847.
 - a. Base Metal and Finish for Interior Applications: Uncoated or zinc-coated (galvanized) steel sheet, with uncoated steel sheet painted after fabrication into lath.
 - b. Configuration over Studs and Furring: Flat.
 - c. Weight: 2.5 lb/sq. yd.
 - 3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed
- B. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
 - 1. Basis-Of-Design Manufacturer: Subject to compliance with requirements, provide products by Custom Building Products or an approved substitution.
 - 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- C. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.
 - 1. Basis-Of-Design Manufacturer: Subject to compliance with requirements, provide products by Custom Building Products or an approved substitution.
 - 2. Verify adhesives have a VOC content of 65 g/L or less.
 - 3. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

2.7 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.
 - 1. Basis-Of-Design Manufacturer: Subject to compliance with requirements, provide products by Custom Building Products or an approved substitution.
 - 2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

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2.8 MISCELLANEOUS MATERIALS

- A. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D4397, 4.0 mils thick.
- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.9 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION OF CERAMIC TILE

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors in laundries.
 - c. Tile floors consisting of tiles 8 by 8 inches or larger.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.

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2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
1. Porcelain Tile: 3/8 inch.
- G. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in improved modified dry-set mortar (thinset).
 2. Do not extend waterproof membrane or crack isolation membrane under thresholds set in modified dry-set or improved modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on waterproof membrane or crack isolation membrane with elastomeric sealant.
- H. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.4 INSTALLATION OF WATERPROOF MEMBRANES

- A. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- B. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.5 INSTALLATION OF CRACK ISOLATION MEMBRANES

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
- B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.6 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 1. Remove grout residue from tile as soon as possible.

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2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 1. Ceramic Tile Installation: TCNA F121 and ANSI A108.1B; cement mortar bed (thickset) on waterproof membrane.
 - a. Tile Type: Porcelain.
 - b. Bond Coat for Cured-Bed Method: Latex- portland cement mortar.
 - c. Grout: Water-cleanable epoxy grout.
 2. Ceramic Tile Installation: TCNA F125; Thinset mortar on crack isolation membrane.
 - a. Tile Type: Porcelain.
 - b. Thinset Mortar: Modified dry-set mortar.
 - c. Grout: High-performance sanded.
- B. Interior Wall Installations, Wood or Metal Studs or Furring:
 1. TCNA W231/241: Method ANSI A108.1A. Cement mortar bed (thickset) bonded to substrate.
 - a. Ceramic Tile Type: .
 - b. Bond Coat for Cured-Bed Method: Dry-set mortar.
 - c. Grout: High-performance unsanded cement grout.
 - d. Joint Width: 3/16 inch.
 2. TCNA W245 or TCNA W248: Thinset mortar on glass-mat, water-resistant gypsum backer board.

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- a. Ceramic Tile Type: WT1.
- b. Thinset Mortar: Improved modified dry-set mortar.
- c. Grout: Standard sanded cement grout.

END OF SECTION 093013

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SECTION 095113 - ACOUSTICAL PANEL CEILINGS

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 acoustical panels and exposed suspension systems for interior ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
- C. Samples for Initial Selection: For components with factory-applied finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Panels: Set of 6-inch-square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch-long Samples of each type, finish, and color.
 - 3. Clips: Full-size seismic clips.
- E. Delegated-Design Submittal: For seismic restraints for ceiling systems.
 - 1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

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1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Ceiling suspension-system members.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Method of attaching hangers to building structure.
 - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 - 4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
 - 5. Size and location of initial access modules for acoustical panels.
 - 6. Items penetrating finished ceiling and ceiling-mounted items including the following:
 - a. Lighting fixtures.
 - b. Diffusers.
 - c. Grilles.
 - d. Speakers.
 - e. Sprinklers.
 - f. Access panels.
 - g. Perimeter moldings.
 - 7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
 - 8. Minimum Drawing Scale: 1/4 inch = 1 foot.
- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

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1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.8 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup of typical ceiling area as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system 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 seismic restraints for ceiling systems.
- B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class B according to ASTM E1264.
 - 2. Smoke-Developed Index: 50 or less.
- D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Ceiling & Wall Solutions; Kitchen Zone or an approved substitution.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
 - 1. Color: White.
 - 2. Light Reflectance (LR): Not less than 0.89.
 - 3. Sound Blocking (CAC): 33.
 - 4. Edge/Joint Detail: Square Tegral
 - 5. Thickness: 5/8 inch.
- C. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

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2.4 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Ceiling & Wall Solutions; Prelude Plus XL or an approved substitution.
- B. Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
 - 1. Structural Classification: ASTM C 635 duty
 - 2. Color: White Aluminum and match the actual color of the selected ceiling tile, unless noted otherwise.
- C. Attachment Devices:
 - 1. Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

2.5 ACCESSORIES

- A. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 - 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.135-inch- diameter wire.
- B. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- C. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.
- E. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- F. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Ceiling & Wall Solutions; AL7801 or an approved substitution.

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- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
 - 2. For lay-in panels with reveal edge details, provide.
 - 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.

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1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.

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3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
 - E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
 - F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
 1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - b. Install panels with pattern running in one direction parallel to long axis of space.
 - c. Install panels in a basket-weave pattern.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 3. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 5. Install hold-down and seismic clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
 - a. Hold-Down Clips: Space 24 inches o.c. on all cross runners.
 6. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.
- 3.4 ERECTION TOLERANCES
- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
 - B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- 3.5 FIELD QUALITY CONTROL
- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

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- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
 - 1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
 - 2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

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SECTION 096513 - RESILIENT BASE AND ACCESSORIES

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. Resilient base.
- 2. Floor Transition Strips.

- B. Related Requirements:

- 1. Section 017419 "Construction Waste and Disposal".
- 2. Section 042000 "Unit Masonry".
- 3. Section 092900 "Gypsum Board"

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.
- C. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

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- B. Mockups: Provide resilient products with mockups specified in other Sections.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.7 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Patcraft; finishworx or a comparable product by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Flexco Corporation.
 - 3. Johnsonite; a Tarkett company.
 - 4. Roppe Corporation; Roppe Holding Company.
- B. Resilient Base Standard: ASTM F 1861.
 - 1. See Drawings Finish Schedule Sheet AE620
 - 2. Style: Straight, unless otherwise indicated.
- C. Minimum Thickness: 0.125 inch.
- D. Height: 6 inches unless otherwise indicated on Drawings, unless otherwise indicated and match existing.
- E. Lengths: Coils in manufacturer's standard length.

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- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Finish: As selected by Architect from manufacturer's full range.
- I. Colors and Patterns: Refer to Sheet AE 620.

2.2 RESILIENT MOLDING ACCESSORY

- A. Resilient Molding Accessory:
 - 1. Coordinate with Owner and Architect for locations of removing existing and installation of new.
 - 2. Basis-Of-Design Product: Subject to compliance with requirements, provide Patcraft; TotalWorx or an approved substitution.
- B. Material: Rubber.
- C. Profile and Dimensions: See Drawings Finish Schedule Sheet AE620.
- D. Colors and Patterns: See Drawings Finish Schedule Sheet AE620.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24, except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
- D. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

- A. Coordinate with Owner and Architect where wall base is to be removed and new wall base installed.
- B. Comply with manufacturer's written instructions for installing resilient base.
- C. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- D. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- E. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- F. Do not stretch resilient base during installation.
- G. Job-Formed Corners:

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1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 1. Remove adhesive and other blemishes from exposed surfaces.
 2. Sweep and vacuum surfaces thoroughly.
 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
 1. Apply three coat(s) where recommended by manufacturer.
- E. Cover resilient products until Substantial Completion.

END OF SECTION 096513

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SECTION 096519 - RESILIENT TILE FLOORING

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. Luxury Vinyl Plank Floor.
- B. Related Sections include:
 - 1. Section 096513 "Resilient Base and Accessories".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- C. Samples: Full-size units of each color and pattern of floor tile required.
- D. Product Schedule: For floor tile. Use same designations indicated on Drawings.
Letter from the Manufacturer: Prior to starting work and with the shop drawing submittal, provide a letter stating that the floor is acceptable for the installation of the product. See item # 3.1.A.2 below for details.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

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1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

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2.2 LUXURY VINYL PLANK

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Patcraft; Material Edit or an approved substitution meeting the following requirements:
- B. Performance requirements:
 - 1. Testing:

a. HUD/FHA	Passes
b. Flexibility (ASTM F137)	Passes
c. Dimensional Stability (ASTM F2199)	Passes
d. Squareness (ASTM F2055)	Passes
e. Residual Indentation (ASTM F1914)	Passes
f. Flooring Radiant Panel (ASTM E648)	Passes - Class 1; ≥ 0.45 watts/cm ²
g. Smoke Density (ASTM E662)	Passes - ≤ 450
h. Slip Resistance (ASTM C1028)	Passes - ≥ 0.5 , meets SCOF for ADA walking surfaces
i. Resistance to Light (ASTM F1515)	Passes
j. Chemical Resistance (ASTM F925)	Passes
k. Resistance to Heat (ASTM F1514)	Passes
 - 2. Environmental Data
 - a. Indoor Air Quality FloorScore Certified; CDPH v1.2-2017
 - b. Product Declarations Third Party Verified EPD, HPD
 - c. Carbon Offset 105% Cradle to Gate (A1 - A3)
- C. Total Thickness: 0.197 inches.
- D. Wear Layer Thickness: 20 mil
- E. Wear Layer: Manufacturer's standard.
- F. Edge Treatment: Square
- G. Seamless-Installation Method: Adhered.
- H. Color and Size: Refer to interior finish legend on Drawing Sheet A620.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
 - 1. Adhesives shall comply with the following limits for VOC content:

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- a. Composition Tile Adhesives: 50 g/L or less.
- 2. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
 - 2. It is the General Contractor's responsibility to assure that all floor slabs are not greater than the maximum moisture content, relative humidity and other requirements of each floor finish manufacturer's product, prior to the flooring installation. If the floor slab exceeds the maximum moisture content, relative humidity and other requirements of of each floor finish manufacturer's product, the General Contractor will be responsible for the concrete slats that pose conditions affecting the performance of the finished floor, including providing proper surface preparation and surface chemical treatment as needed to provide aa concrete surface that meets the requirements or/and approval of each floor finish manufacturer's product and will be performed at no additional cost to the owner. The General Contractor will be responsible to coordinate with the floor finish manufacturer for acceptance of the measures that will be used to correct moisture content, relative humidity and other requirements od each floor finish manufacturer, prior to the flooring installation. Approval from the finish floor manufacturer is required prior to starting the installation of any flooring.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

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2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 4. Moisture Testing: See item # 3.1.A.2
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles as indicated on drawings.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
1. Lay tiles with grain running in one direction, unless otherwise indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

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3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish; Apply two coat(s).
- E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096813 - TILE CARPETING

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. Modular carpet tile.

- B. Related Requirements:

- 1. Section 017419 "Construction Waste and Disposal".
 - 2. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.

- B. Shop Drawings: For carpet tile installation, plans showing the following:

- 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.

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2. Carpet tile type, color, and dye lot.
 3. Type of installation.
 4. Pattern of installation.
 5. Pattern type, location, and direction.
 6. Pile direction.
 7. Type, color, and location of insets and borders.
 8. Type, color, and location of edge, transition, and other accessory strips.
 9. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet Tile: Full-size Sample.
 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.
- D. Samples for Initial Selection: For each type of carpet tile.
1. Include Samples of exposed edge, transition, and other accessory stripping involving color or finish selection.
- E. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet Tile: Full-size Sample.
 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.
- F. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- G. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
 - B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
 - C. Sample Warranty: For special warranty.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.

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2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Carpet and Rug Institute's CRI 104.

1.10 FIELD CONDITIONS

- A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 2. Failures include, but are not limited to, the following:
 - a. More than 10 percent edge raveling, snags, and runs.
 - b. Dimensional instability.

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- c. Excess static discharge.
- d. Loss of tuft-bind strength.
- e. Loss of face fiber.
- f. Delamination.
- g. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE – C1:

A. Basis-of-Design Product: Subject to compliance with requirements, provide Patcraft; Deconstructed Form or an approved substitution.

- 1. Color: Graphic Arc; 10597.
- 2. Pattern: As noted on finish schedule, see Sheet A620 for additional information.
- 3. Size: 18 by 36 inches nominal.

B. Properties:

- | | |
|-----------------------------|------------------------------|
| 1. Construction: | Multi-Level Pattern Cut/Loop |
| 2. Fiber: | ecosolution q100™ nylon |
| 3. Dye Method: | 100% solution dyed |
| 4. Backing: | ecoworx® tile |
| 5. Gauge: | 1/10 inches |
| 6. Stitches: | 10 per inches |
| 7. Finished Pile Thickness: | Finished 0.116 inches |
| 8. Average Density: | 11483 oz/yd ³ |
| 9. Total Thickness: | 0.331 inches |
| 10. Tufted Weight: | 0. |

C. Applied Treatments:

- 1. Soil-Resistance Treatment: Manufacturer's standard treatment.

2.2 CARPET TILE – C2:

A. Basis-of-Design Product: Subject to compliance with requirements, provide Patcraft; Deconstructed Form or an approved substitution.

- 1. Color: Graphic Arc; 10597.
- 2. Pattern: As noted on finish schedule, see Sheet A620 for additional information.
- 3. Size: 18 by 36 inches nominal.

B. Properties:

- | | |
|------------------|------------------------------|
| 1. Construction: | Multi-Level Pattern Cut/Loop |
| 2. Fiber: | ecosolution q100™ nylon |
| 3. Dye Method: | 100% solution dyed |

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- | | | |
|-----|--------------------------|--------------------------|
| 4. | Backing: | ecoworx® tile |
| 5. | Gauge: | 1/10 inches |
| 6. | Stitches: | 10 per inches |
| 7. | Finished Pile Thickness: | Finished 0.116 inches |
| 8. | Average Density: | 11483 oz/yd ³ |
| 9. | Total Thickness: | 0.331 inches |
| 10. | Tufted Weight: | 0. |

C. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.
- C. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 1. Verify that adhesives have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
 2. It is the General Contractor's responsibility to assure that all floor slabs are not greater than the maximum moisture content, relative humidity and other requirements of each floor finish manufacturer's product, prior to the flooring installation. If the floor slab exceeds the maximum moisture content, relative humidity and other requirements of each floor finish manufacturer's product, the General Contractor will be responsible for the concrete slabs that pose conditions affecting the performance of the finished floor, including providing proper surface preparation and surface chemical treatment as needed to provide a concrete

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surface that meets the requirements or/and approval of each floor finish manufacturer's product and will be performed at no additional cost to the owner. The General Contractor will be responsible to coordinate with the floor finish manufacturer for acceptance of the measures that will be used to correct moisture content, relative humidity and other requirements of each floor finish manufacturer, prior to the flooring installation. Approval from the finish floor manufacturer is required prior to starting the installation of any flooring.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

3.3 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: See item # 3.1.A.2
- C. Installation Method: As recommended in writing by carpet tile manufacturer.
- D. Maintain dye-lot integrity. Do not mix dye lots in same area.
- E. Maintain pile-direction patterns indicated on Drawings.
- F. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

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- G. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- H. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- I. Install pattern parallel to walls and borders.
- J. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

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SECTION 097200 - WALL COVERINGS

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. Vinyl wall covering.
- 2. Textile wall covering.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.

- B. Sustainable Design Submittals:

- 1. Product Data: For adhesives, indicating VOC content.
- 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

- C. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement seams and termination points.

- D. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36 inches long in size.

- 1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments applied.

- a. Show complete pattern repeat.

- E. Product Schedule: For wall coverings. Use same designations indicated on Drawings.

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1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

1.8 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.
 - 1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F1141 for appearance shading characteristics.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.
- B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.
 - 2. Fire-Growth Contribution: No flashover and heat and smoke release when tested in accordance with NFPA 286.

2.2 VINYL WALL COVERING

- A. Wall Covering W2:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide MDC Interior Solutions; Designer Gallery or an approved substitution meeting the following requirements:
 - a. Description: Provide vinyl products in rolls from same production run and complying with the following:
 - 1) for Type II, Medium Duty.
 - 2. Total Weight: 13.33 oz./yd², excluding coatings.
 - 3. Width: 50.5 inches.
 - 4. Backing: Nonwoven backed mylar.
 - 5. Repeat: 50.5 inches.
 - 6. Colors, Textures, and Patterns: Blue Agate; DGC1054.
- B. Wall Covering W3:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Knoll; The Atmosphere Collection by Trove or an approved substitution meeting the following requirements:
 - a. Description: Provide vinyl products in rolls from same production run and complying with the following:
 - 1) for Type II, Medium Duty.

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- b. Total Weight: 18 oz./yd², excluding coatings.
- c. Width: 51 inches.
- d. Backing: Polyester / Cellulose.
- e. Repeat: H: 51.0, V: 120.0 inches.
- f. Colors, Textures, and Patterns: 1 Polar.

C. Wall Covering W4:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide MDC Interior Solutions; Esquire Collection or an approved substitution meeting the following requirements:
 - a. Description: Provide vinyl products in rolls from same production run and complying with the following:
 - 1) for Type II, Medium Duty.
 - b. Total Weight: 13.33 oz./yd², excluding coatings.
 - c. Width: 52/54 inches.
 - d. Backing: Osnaburg.
 - e. Repeat: Random reversible.
 - f. Colors, Textures, and Patterns: Tidal; Sapphire MEI3210.

D. Wall Covering W5:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide MDC Interior Solutions; Esquire Collection or an approved substitution meeting the following requirements:
 - a. Description: Provide vinyl products in rolls from same production run and complying with the following:
 - 1) for Type II, Medium Duty.
 - b. Total Weight: 13.33 oz./yd², excluding coatings.
 - c. Width: 52/54 inches.
 - d. Backing: Osnaburg.
 - e. Repeat: Random reversible.
 - f. Colors, Textures, and Patterns: Tidal; Emerald MEI3207.

2.3 TEXTILE WALL COVERING

A. Wall Covering W1:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Chilewich; Shuttle or an approved substitution meeting the following requirements:
 - a. Description: Provide wall coverings in rolls from same production run and that comply with the following:

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- 1) ASTM F793/F793M: Category VI, Type III, Commercial Serviceability (Vinyl Coated).
- b. Test Responses:
 - 1) Colorfastness to Light: Complies with AATCC 16.2 Test Option 1 or AATCC 16.3 Test Option 3, Class L4, minimum, at 40 hours.
- c. Total Weight: 0.19 lbs./ft², excluding coatings.
- d. Width: 72 inches.
- e. Repeat: Random.
- f. Applied Backing Material: Trilam; Manufacturer's Standard.
- g. Features:
 - 1) Stain-Resistant Coating.
 - 2) Strippable.
 - 3) Phthalate free.
 - 4) Heavy-metals free.
 - 5) Halogenated-fire-retardant free.
- h. Colors, Textures, and Patterns: Orbit.

2.4 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.
 - 1. Verify adhesives have a VOC content of 50 <Insert value> g/L or less.
- B. Primer/Sealer: Mildew resistant and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.
- C. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation surfaces being true in plane and vertical and horizontal alignment, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
 - 2. Plaster: Allow plaster to cure for at least 90 days. Neutralize areas of high alkalinity. Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 3. Metals: If not factory primed, clean and apply metal primer as recommended in writing by metal-primer manufacturer and wall-covering manufacturer.
 - 4. Gypsum Board: Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 5. Painted Surfaces:
 - a. Check for pigment bleeding. Apply primer/sealer to areas susceptible to pigment bleeding as recommended in writing by primer/sealer manufacturer.
 - b. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.
- D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 INSTALLATION OF WALL COVERING

- A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.
- B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
- D. Install wall covering without lifted or curling edges and without visible shrinkage.
- E. Match pattern 72 inches above the finish floor.
- F. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.

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- G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
- H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

END OF SECTION 097200

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SECTION 098433 - SOUND-ABSORBING WALL UNITS

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 shop-fabricated, acoustical panel units tested for acoustical performance, including the following:
 - 1. Sound-absorbing baffle panels.

1.3 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For unit assembly and installation.
 - 1. Include reflected ceiling plans, elevations, sections, and mounting devices and details.
 - 2. Include details at joints and corners; and details at ceiling intersections and intersections with walls. Indicate panel edge profile and core materials.
 - 3. Include direction of fabric weave and pattern matching.
- C. Samples for Initial Selection: For each type of fabric facing.
 - 1. Include Samples of hardware and accessories involving color or finish selection.
- D. Samples for Verification: For the following products:

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1. Fabric: Full-width by approximately 24-inch long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
2. Panel Edge: 12-inch-long Sample(s) showing each edge profile, corner, and finish.
3. Core Material: 12-inch-square Sample at corner.
4. Mounting Devices: Full-size Samples.
5. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Electrical outlets.
 2. Suspended ceiling components above ceiling units.
 3. Structural members to which suspension devices will be attached.
 4. Items penetrating or covered by units including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Alarms.
 - e. Sprinklers.
 - f. Access panels.
 5. Show operation of hinged and sliding components covered by or adjacent to units.
- B. Product Certificates: For each type of unit.
- C. Sample Warranty: For manufacturer's special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturer's written cleaning and stain-removal instructions.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fabric: For each fabric, color, and pattern installed, furnish length equal to 10 percent of amount installed, but no fewer than 10 sq. yd., full width of bolt.
 2. Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than five devices.

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1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect units from exposure to airborne odors, and install units under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Acoustical performance.
 - b. Fabric sagging, distorting, or releasing from panel edge.
 - c. Warping of core.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

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1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.2 SOUND-ABSORBING WALL UNITS

- A. Sound-Absorbing Wall Panel (AP1): Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Frasca; StrataWood or an approved substitution meeting the following requirements:
 - a. Panel Shape: As indicated on Drawings.
 - b. Mounting: Screw attached to substrate.
 - c. Core: Manufacturer's standard.
 - d. Edge Construction: Manufacturer's standard frame.
 - e. Edge Profile: Square.
 - f. Corner Detail in Elevation: Square.
 - g. Acoustical Performance: Sound absorption of minimum 0.55 according to ASTM C423 for Type A mounting according to ASTM E795.
 - h. Nominal Overall Panel Thickness: .87 inch.
 - i. Panel Width: As indicated on Drawings.
 - j. Panel Height: As indicated on Drawings.
- B. Sound-Absorbing Wall Panel (AP2): Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Truf Design, Inc.; Static or an approved substitution meeting the following requirements:
 - a. Panel Shape: As indicated on Drawings.
 - b. Mounting: Aluminum standoffs secured to substrate.
 - c. Core: Manufacturer's standard.
 - d. Edge Construction: Manufacturer's standard.
 - e. Edge Profile: Manufacturer's standard.
 - f. Corner Detail in Elevation: Square with continuous edge profile indicated.
 - g. Reveals between Panels: Recessed reveals.
 - h. Acoustical Performance: Sound absorption NRC of 0.25 to 0.50 according to ASTM C423 for Type A mounting according to ASTM E795.
 - i. Nominal Overall Panel Thickness: 9 mm.
 - j. Panel Width: As indicated on Drawings.

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- k. Panel Height: As indicated on Drawings.

2.3 MATERIALS

- A. Core Materials: Manufacturer's standard.
 - 1. Fire-Retardant Formed Plastic: Manufacturer's standard formed plastic with flame-spread index of 25 or less and smoke-developed index of 25 or less according to ASTM E84 or UL 723.
- B. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit.

2.4 FABRICATION

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:
 - 1. Thickness.
 - 2. Edge straightness.
 - 3. Overall length and width.
 - 4. Squareness from corner to corner.
 - 5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with edges in alignment with walls and other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align fabric pattern and grain with adjacent units.

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3.3 INSTALLATION TOLERANCES

- A. Variation from Alignment with Surfaces: Plus or minus 1/16 inch in 48 inches, noncumulative.
- B. Variation from Level or Slope: Plus or minus 1/16 inch.
- C. Variation of Joint Width: Not more than 1/16 inch wide from hairline in 48 inches, noncumulative.

3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 098433

SECTION 098436 - SOUND-ABSORBING CEILING UNITS

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 shop-fabricated, acoustical panel units tested for acoustical performance, including the following:
 - 1. Sound-absorbing Polyester felt fiber baffle panels.
 - 2. Sound-absorbing Polyester felt fiber ceiling panels.
- B. Related Sections:
 - 1. Section 054300 "Slotted Channel Framing System" for support framing.
 - 2. Section 095113 "Acoustical Panel Ceilings" for suspension grid ceilings.

1.3 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For unit assembly and installation.
 - 1. Include reflected ceiling plans, elevations, sections, and mounting devices and details.
 - 2. Include details at joints and corners; and details at ceiling intersections and intersections with walls. Indicate panel edge profile and core materials.
 - 3. Include direction of fabric weave and pattern matching.

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- C. Samples for Initial Selection: For each type of fabric facing.
 - 1. Include Samples of hardware and accessories involving color or finish selection.
- D. Samples for Verification: For the following products:
 - 1. Fabric: Full-width by approximately 24-inch long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
 - 2. Panel Edge: 12-inch-long Sample(s) showing each edge profile, corner, and finish.
 - 3. Core Material: 12-inch-square Sample at corner.
 - 4. Mounting Devices: Full-size Samples.
 - 5. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Electrical outlets.
 - 2. Suspended ceiling components above ceiling units.
 - 3. Structural members to which suspension devices will be attached.
 - 4. Items penetrating or covered by units including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Alarms.
 - e. Sprinklers.
 - f. Access panels.
 - 5. Show operation of hinged and sliding components covered by or adjacent to units.
- B. Product Certificates: For each type of unit.
- C. Sample Warranty: For manufacturer's special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturer's written cleaning and stain-removal instructions.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

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1. Fabric: For each fabric, color, and pattern installed, furnish length equal to 10 percent of amount installed, but no fewer than 10 sq. yd., full width of bolt.
2. Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than five devices.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect units from exposure to airborne odors, and install units under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Acoustical performance.
 - b. Fabric sagging, distorting, or releasing from panel edge.
 - c. Warping of core.
 2. Warranty Period: Two years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain ceiling units specified in this Section from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.

2.3 SOUND-ABSORBING CEILING UNITS (AP3)

- A. Sound-Absorbing Baffle Panel: Manufacturer's standard panel construction consisting of Polyethylene Terephthalate (PET) felt front and back faces and edge-framed core and bonded or attached to edges.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Truf Design, Inc.; Beam or an approved substitution meeting the following requirements:
 - a. Nominal Overall Panel Thickness: 0.87 inches.
 - b. Shape: Rectangular.
 - c. Edge: Square.
 - d. Color: Refer to A620 for colors and locations.
 - e. Suspension Method: 9/16-inch Tee Grid.
 - 2. Properties:
 - a. NRC (ASTM C423): 0.55.
 - b. Flammability: ASTM E84; Class B
 - c. Environmental: 100% Recyclable PET felt with minimum of 55% post-consumer recycled content.

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2.4 SOUND-ABSORBING CEILING UNITS (AP4)

- A. Sound-Absorbing Baffle Panel: Manufacturer's standard panel construction consisting of Polyethylene Terephthalate (PET) felt front and back faces and edge-framed core and bonded or attached to edges.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Truf Design, Inc.; Beam or an approved substitution meeting the following requirements:
 - a. Nominal Overall Panel Thickness: 3Wx4H inches.
 - b. Shape: Rectangular.
 - c. Edge: Covered Folded Edge.
 - d. Color: Refer to A620 for colors and locations.
 - e. Suspension Method: 9/16-inch Tee Grid.
 - f. Ceiling Attachment (for Suspension Cable only): Ceiling Mounting Plate.
 - 2. Properties:
 - a. NRC (ASTM C423): 1.5.
 - b. Flammability: ASTM E84; Class A
 - c. Environmental: 00% Recyclable PET felt with minimum of 60% pre-consumer recycled content.

2.5 SOUND-ABSORBING CEILING UNITS (AP5)

- A. Sound-Absorbing Baffle Panel: Manufacturer's standard panel construction consisting of Polyethylene Terephthalate (PET) felt front and back faces and edge-framed core and bonded or attached to edges.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Truf Design, Inc.; Port or an approved substitution meeting the following requirements:
 - a. Nominal Overall Panel Thickness: 4 inches.
 - b. Shape: Square.
 - c. Edge: Covered Folded Edge.
 - d. Color: Refer to A620 for colors and locations.
 - e. Suspension Method: 9/16-inch Tee Grid.
 - f. Ceiling Attachment (for Suspension Cable only): Ceiling Mounting Plate.
 - 2. Properties:
 - a. NRC (ASTM C423): 1.0.
 - b. Flammability: ASTM E84; Class A
 - c. Environmental: 00% Recyclable PET felt with minimum of 60% pre-consumer recycled content.

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2.6 SOUND-ABSORBING CEILING UNITS (AP7)

- A. Sound-Absorbing Baffle Panel: Manufacturer's standard panel construction consisting of Polyethylene Terephthalate (PET) felt front and back faces and edge-framed core and bonded or attached to edges.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Truf Design, Inc.; Drop or an approved substitution meeting the following requirements:
 - a. Nominal Overall Panel Thickness: 4 inches.
 - b. Shape: Rectangular; folded.
 - c. Edge: Manufacturer's standard.
 - d. Color: Refer to A620 for colors and locations.
 - e. Suspension Method: Unistrut P1000T.
 - f. Ceiling Attachment (for Suspension Cable only): Ceiling Mounting Plate.
 - 2. Properties:
 - a. NRC (ASTM C423): 1.0.
 - b. Flammability: ASTM E84; Class A
 - c. Environmental: 00% Recyclable PET felt with minimum of 60% pre-consumer recycled content.

2.7 MATERIALS

- A. Core Materials: Manufacturer's standard.
- B. Facing Material: Fabric from same dye lot; color and pattern as selected by Architect from manufacturer's full range.
- C. Mounting Devices: Concealed on back or top edge of unit, recommended by manufacturer to support weight of unit.

2.8 FABRICATION

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated, with facing material applied to face, edges, and back border of dimensionally stable core and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Measure each area and establish layout of panels and joints of sizes indicated on Drawings within a given area.
- C. Facing Material: Felt; 100% Wool Design Felt, 100 percent biodegradable.
- D. Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
- E. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

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1. Thickness.
2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.
5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with edges in alignment with walls and other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align fabric pattern and grain with adjacent units.

3.3 INSTALLATION TOLERANCES

- A. Variation from Alignment with Surfaces: Plus or minus 1/16 inch in 48 inches, noncumulative.
- B. Variation from Level or Slope: Plus or minus 1/16 inch.
- C. Variation of Joint Width: Not more than 1/16 inch wide from hairline in 48 inches, noncumulative.

3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 098436

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SECTION 099123 - INTERIOR PAINTING

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 surface preparation and the application of paint systems on interior substrates.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
 - 2. Section 081113 "Hollow Metal Doors and Frames"
 - 3. Section 092900 "Gypsum Board" surface preparation.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

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1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
1. Submit Samples on rigid backing, 8 inches square.
 2. Apply coats on Samples in steps to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
 - b. Other Items: Architect will designate items or areas required.
 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply 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 less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. PPG Paints.
 - 3. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall 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 shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As selected by Architect.

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2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

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:
1. Concrete: 12 percent.
 2. Wood: 15 percent.
 3. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. 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.

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- 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. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 2.
 - 2. SSPC-SP 3.
 - 3. SSPC-SP 7/NACE No. 4.
 - 4. SSPC-SP 11.
- G. 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.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.

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2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. 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.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 2. Paint the following work where exposed 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.
 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

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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. Contractor shall 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, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- 1. Latex System: (Doors and Frames) – Light Industrial Coating
 - a. Prime Coat: Shop primer specified in Section where substrate is specified.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.
 - 1) Benjamin Moore: Ultra Spec 500; Waterborne Interior Eggshell.
 - 2) PPG Architectural: Speedhide Zero Interior Zero VOC Latex Satin.
 - 3) Pratt & Lambert: Pro Hide Gold Ultra; Interior Latex Mid Sheen.
 - 4) Sherwin Williams: ProMar 200 Zero VOC; Interior Latex Eg-Shel.
- B. Plastic Substrates:
 - 1. Institutional Low-Odor/VOC Latex System MPI INT 6.8F:
 - a. Prime Coat: Primer, bonding, solvent based, MPI #17.
 - 1) Benjamin Moore: Fresh Start; Multi-Purpose Latex Primer.
 - 2) PPG Architectural: Seal Grip Int/Ext Acrylic Universal Primer/Sealer.
 - 3) Pratt & Lambert: Pro Hide Gold Ultra; Interior Exterior Waterborne Primer.

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- 4) Sherwin Williams: Multi-Purpose; Multi-Purpose Latex Primer/Sealer.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.
 - 1) Benjamin Moore: Regal Select; Premium Interior Semi-Gloss Finish.
 - 2) PPG Architectural: Speedhide Zero Interior Zero VOC Latex Semi-Gloss.
 - 3) Sherwin Williams: Emerald; Interior Acrylic Latex Semi Gloss.
- C. Gypsum Board Substrates:
1. Latex over Latex Sealer System MPI INT 9.2A:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - 1) Benjamin Moore: Ultra Spec 500; Waterborne Interior Primer Sealer.
 - 2) PPG Architectural: Speedhide Zero Interior Zero VOC Latex Sealer.
 - 3) Pratt & Lambert: Pratt & Lambert: Int/Ext Multi-Purpose Waterborne Primer.
 - 4) Sherwin Williams: ProMar 200 Zero; Interior Latex Primer.
 - b. Prime Coat: Latex, interior, matching topcoat.
 - c. Intermediate Coat: Latex, interior, matching topcoat.
 - d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44. (Storage, electrical and mechanical)
 - 1) Benjamin Moore: Ultra Spec 500; Interior Low Sheen Finish.
 - 2) PPG Architectural: Speedhide Zero Interior Zero VOC Latex Eggshell.
 - 3) Pratt & Lambert: Pro Hide Gold Ultra; Interior Latex Eggshell.
 - 4) Sherwin Williams: ProMar 200 Zero VOC; Interior Latex Low Sheen.
 - e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.
 - 1) Benjamin Moore: Ultra Spec 500; Waterborne Interior Eggshell.
 - 2) PPG Architectural: Speedhide Zero Interior Zero VOC Latex Satin.
 - 3) Pratt & Lambert: Pro Hide Gold Ultra; Interior Latex Mid Sheen.
 - 4) Sherwin Williams: ProMar 200 Zero VOC; Interior Latex Eg-Shel.
 - f. Topcoat: Epoxy, High Build, Low-gloss (MPI Gloss Level 4), MPI #108. (Restrooms, Decon Laundry, Laundry)
 - 1) Benjamin Moore: Corotech; Polyamide Epoxy Semi-Gloss.
 - 2) PPG Architectural: Protective and Marine Coatings; Aquapon High Build Epoxy.
 - 3) Sherwin Williams: Protective & Marine; Macropoxy 646 Fast Cure Epoxy.
 - g. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #155. (Ceilings)
 - 1) Benjamin Moore: Dry Fall; Latex Dry Fall.

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- 2) PPG Architectural: Speedhide Super Tech; Interior Latex Dry-Fog.
- 3) Pratt & Lambert: Krylon Industrial; Waterborne Dry fall.
- 4) Sherwin Williams: Pro Industrial; Waterborne Acrylic Dryfall.

END OF SECTION 099123

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SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

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 room-identification signs that are directly attached to the building.
- B. Related Requirements:
 - 1. Section 1011419 "Dimensional Letter Signage" for building signage.

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For room-identification signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.

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3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
 - D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 1. Include representative Samples of available typestyles and graphic symbols.
 - E. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 1. Room-Identification Signs: Full-size Sample.
 2. Exposed Accessories: Full-size Sample of each accessory type.
 3. Full-size Samples, if approved, will be returned to Contractor for use in Project.
 - F. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer and manufacturer.
 - B. Sample Warranty: For special warranty.
- 1.7 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For signs to include in maintenance manuals.
- 1.8 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Tools: One set(s) of specialty tools for assembling signs and replacing variable sign components.
- 1.9 QUALITY ASSURANCE
- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

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1.10 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign (Sheet AE700): Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. 3 Form.
 - b. Best Sign Systems, Inc.
 - c. Graphik Display & Sign
 - d. Hightech Signs
 - e. Impact Signs
 - f. Approved Substitution.
 - 2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to Acrylic Resin backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: As indicated on Drawings.

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- b. Surface-Applied Graphics: Applied vinyl film.
 - c. Color(s): As selected by Architect from manufacturer's full range.
 3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: As indicated on Drawings.
 - b. Corner Condition in Elevation: As indicated on Drawings.
 4. Mounting:
 - a. Room Signage: Manufacturer's standard method for surface mounting to wall.
 - b. Area Signage: Manufacturer's standard method for ceiling suspension mounting.
 5. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.
- B. Panel Sign (Sheet AE700): Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 1. Solid-Sheet Sign: Steel sheet with finish specified in "Surface Finish and Applied Graphics" Subparagraph and as follows:
 - a. Thickness: 0.080 inch.
 - b. Surface-Applied, Raised Graphics: Applied polymer characters and Braille.

2.3 SIGN MATERIALS

- A. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3 and the following requirements:
 1. Faces: Grade HGS.
 2. Backs: Grade BKH.
 3. Exposed Edges: Same as faces.
- B. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- C. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings.
- D. Steel Materials:
 1. Steel Sheet: Uncoated, cold-rolled, ASTM A1008/A1008M, commercial steel, Type B, exposed.

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2. For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
 - b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.
- B. Adhesive: As recommended by sign manufacturer.
 1. Verify adhesives have a VOC content of 70 g/L or less.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard.
- C. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - 2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
 - 3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

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END OF SECTION 101423.16

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SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS

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. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens. Non-sight line type.

B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for supports that attach floor-anchored, overhead braced compartments to overhead structural system.
- 2. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Sustainable Design Submittals:

- 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
- 2. Environmental Product Declaration: For each product.
- 3. Health Product Declaration: For each product.
- 4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Shop Drawings: For toilet compartments.

- 1. Include plans, elevations, sections, details, and attachment details.
- 2. Show locations of centerlines of toilet fixtures.
- 3. Show locations of floor drains.
- 4. Show overhead support or bracing locations.

D. Samples for Initial Selection: For each type of toilet compartment material indicated.

1. Include Samples of hardware and accessories involving material and color selection.
- E. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
 2. Each type of hardware and accessory.
- F. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Product Certificates: For each type of toilet compartment.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For toilet compartments to include in maintenance manuals.
- 1.6 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Door Hinges: 10 hinge(s) with associated fasteners.
 2. Latch and Keeper: 3 latch(es) and keeper(s) with associated fasteners.
 3. Door Bumper: 3 door bumper(s) with associated fasteners.
 4. Door Pull: 3 door pull(s) with associated fasteners.
 5. Fasteners: Ten fasteners of each size and type.
- 1.7 PROJECT CONDITIONS
- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 75 or less.

2. Smoke-Developed Index: 450 or less.

- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 5 percent.
- C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARTMENTS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide ASI Global Partitions; Black Core Phenolic or an approved substitution meeting the requirements herein.
- B. Toilet-Enclosure Style: Overhead braced and Floor anchored. Non-sight line type.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 3/4-inch-thick doors and pilasters and minimum 1/2-inch-thick panels.
- E. Pilaster Shoes and Sleeves (Caps): Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- F. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilaster; with shoe matching that on the pilaster.
- G. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
- H. Phenolic-Panel Finish:
 - 1. Facing Sheet Finish: One color and pattern in each room.
 - 2. Color and Pattern: As selected by Architect from manufacturer's full range, with manufacturer's standard through-color core matching face sheet.
 - 3. Edge Color: Through-color matching facing sheet color.

2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.
 - 1. Hinges: Manufacturer's minimum 0.062-inch-thick stainless steel paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door. Mount with through-bolts.

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2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
 3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
 4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless steel bumper at out-swinging doors. Mount with through-bolts.
 5. Door Pull: Manufacturer's heavy-duty cast-stainless steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

- A. Aluminum Castings: ASTM B26/B26M.
- B. Aluminum Extrusions: ASTM B221.
- C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless Steel Castings: ASTM A743/A743M.

2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at bottoms of posts. Provide shoes at posts to conceal anchorage.

- D. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide in-swinging doors for standard toilet compartments and 36-inch-wide out-swinging doors with a minimum 32-inch-wide clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch.
 - b. Panels and Walls: 1 inch.
 - 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
 - 3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

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3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113.17

SECTION 102243 - SLIDING GLASS PARTITIONS

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 manually operated, glass-panel partitions.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
 - 2. Section 083513.13 "Multiple Folding Aluminum-Framed Folding Glass Doors".

1.3 DEFINITIONS

- A. STC: Sound Transmission Class.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For operable glass-panel partitions.
 - 1. Include plans, elevations, sections, details, numbered panel installation sequence, and attachments to other work.
 - 2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
- C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.
 - 1. Include Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:

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1. Panel Edge Material: Not less than 3 inches long.
 2. Glass: Units 12 inches square.
 3. Hardware: One of each exposed door-operating device.
- E. Delegated-Design Submittal: For operable glass-panel partitions.
1. Include design calculations for seismic restraints that brace tracks to structure above.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Partition track, track supports and bracing, switches, turning space, and storage layout.
 2. Suspended ceiling components.
 3. Structural members to which suspension systems are attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. HVAC ductwork, outlets, and inlets.
 - c. Sprinklers.
 - d. Smoke detectors.
- B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.
- C. Qualification Data: For qualified Installer.
- D. Seismic Qualification Certificates: For operable glass-panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:
1. Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, according to ASCE/SEI 7.
 2. Detailed description of partition anchorage devices on which the certification is based and their installation requirements.
- E. Product Certificates: For each type of operable glass-panel partition.
- F. Product Test Reports: For each operable glass-panel partition, for tests performed by a qualified testing agency.
- G. Sample Warranty: For manufacturer's special warranty.

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1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For operable glass-panel partitions to include in maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Panel finish and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
 - b. Seals, hardware, track, track switches, carriers, and other operating components.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.10 WARRANTY

- A. Manufacturer Warranty: Provide All Glass Center Pivot Partition system manufacturer's standard limited warranty as per manufacturer's published warranty document in force at time of purchase, subject to change, against defects in materials and workmanship.
 - 1. Warranty Period beginning with the earliest of 120 days from Date of Delivery or Date of Substantial Completion:
 - a. Rollers: Ten (10) years
 - b. All Other Components Except Screens: Ten (10) years

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic bracing of tracks to structure above.
- B. Seismic Performance: Operable glass-panel partitions shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

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1. The term "withstand" means "the partition panels will remain in place without separation of any parts when subjected to the seismic forces specified."

C. Performance Criteria (Lab Tested):

1. Forced Entry (AAMA 1304, DIN EN 1191): Pass.
2. Single Action Panels with Offset Hinge - Operation / Cycling Performance
 - a. AAMA 920: 500,000 cycles
3. Project Wind Loads (ASCE 7): System designed to withstand 20 psf (958 Pa) core required positive and negative pressure as minimum loads normal to the plane of the wall as required by authorities having jurisdiction.

D. Design Criteria:

1. Sizes and Configurations: As indicated by the drawings for selected number and size of panels and location of swing panels.
2. Unit Operation: Adjustable center pivot hardware with top tracks and sockets.
3. Panel Type: Folding.
4. Panel Configuration:
 - a. 90° angle turn/ open corner.
 - b. Window/ door combination.
5. Mounting Type: Top-hung
6. Sill Type: Floor sockets with No floor track or sill.

2.2 OPERABLE GLASS PANELS

A. Operable Glass Panels: Aluminum-framed glass-panel partition system, including panels, suspension system, operators, and accessories.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Nana Wall Systems, Inc.; CSW75 or an approved substitution meeting the requirements herein.

B. Panel Operation: Manually operated, continuously hinged panels.

C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

1. Factory-Glazed Fabrication: Glaze operable glass panels in the factory where practical and possible for applications indicated. Comply with manufacturer's written instructions and with requirements in Section 088000 "Glazing."

D. Glass and Glazing: As follows:

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1. Safety Glass Standard for Partition Panels: Glass products complying with testing requirements in 16 CFR 1201, Category II, or ANSI Z97.1, Class A.
 2. Safety Glass Standard for Pass Doors: Glass products complying with testing requirements in 16 CFR 1201, Category II.
 3. Glass: Manufacturer's standard safety glass and glass assemblies as indicated and complying with the following:
 - a. Tempered Glass: ASTM C1048, Kind FT (fully tempered), Type I (transparent flat glass), Class 1 (clear), Quality-Q3.
 - b. Glass Thickness: Manufacturer's standard thickness for indicated requirements.
 4. Glazing System: Manufacturer's standard factory-glazing system.
- E. Dimensions: Fabricate operable glass-panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
1. Panel Width: Equal widths.
- F. Panel Weight: 11 lb/sq. ft. maximum.
- G. Panel Frame Thickness: Nominal dimension of 1-7/8 inches.
- H. Panel Frame Materials:
1. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B221 for extrusions; manufacturer's standard strengths and thicknesses for type of use.
 - a. Frame Reinforcement: Manufacturer's standard steel or aluminum.
- I. Panel Closure: Manufacturer's standard unless otherwise indicated.
- J. Hardware: Manufacturer's standard as required to operate operable glass-panel partition and accessories; with decorative, protective finish.
1. Hinges: Manufacturer's standard.
 2. Floor Lock: Key actuated.
- K. Panel Frame Finishes:
1. Exposed Metal: As selected by Architect from manufacturer's full range as follows:
 - a. Aluminum: Clear anodized.

2.3 SUSPENSION SYSTEMS

- A. Tracks: Steel or aluminum with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of operable glass-panel partition indicated. Size track to support partition operation and storage without damage to suspension system,

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operable glass-panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.
2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.

B. Carrier Hardware:

1. Panels: Provide unidirectional sliding panel carrier attached to the panel with a stainless-steel cast shoe and a stainless-steel ball bearing axle.
 - a. Carriers to be with four (4) glass fiber reinforced polyamide wheels with memory effect, two (2) guiding rollers, and polyamide bumpers to avoid metal on metal contact for quiet and smooth operation.
 - b. Metal-on-metal contact between top-track and carriers NOT acceptable.
2. Maximum carrying capacity of one carrier on a panel to be 330 lbs.
3. Adjustment: Provide system capable of specified amount of adjustments without removing panels from tracks.

C. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.

2.4 ACCESSORIES

A. Pass Doors: Swinging door built into and matching panel materials, construction, finish and thickness, complete with frames and operating hardware. Hinges finished to match other exposed hardware.

1. Accessibility Standard: Fabricate doors to comply with applicable provisions in the ABA standards of the Federal agency having jurisdiction and ICC A117.1.
2. Single Pass Door: 36 by 84 inches.
3. Pass-Door Hardware: Equip pass door with the following:
 - a. Door Seals: Mechanically operated floor seal on panels containing pass doors.
 - b. Panic hardware.
 - c. Concealed door closer.
 - d. Latchset: Passage set.
 - e. Lock: Key-operated lock with cylinder, keyed to master key system, operable from both sides of door. Include two keys per lock.
 - f. Lock: Deadlock to receive cylinder, operable from both sides of door. See Section 087100 "Door Hardware" for lock cylinder and keying requirements.

B. Vertical Edge Trim: Manufacturer's standard trim to protect vertical edges of glass in frameless panels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine flooring, floor levelness, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable glass-panel partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install operable glass-panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.
- B. Install panels in numbered sequence indicated on Shop Drawings.
- C. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- D. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.
- E. Light-Leakage Test: Temporarily opacify glass areas of panels. Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals.

3.3 ADJUSTING

- A. Adjust operable glass-panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust pass doors to operate smoothly and easily, without binding or warping.
- C. Verify that safety devices are properly functioning.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable glass-panel partitions.

END OF SECTION 102239.13

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SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Childcare accessories.
3. Underlavatory guards.

B. Related Requirements:

1. Section 093013 "Ceramic Tiling" for ceramic toilet and bath 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.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Childcare accessories.
4. Underlavatory guards.

B. Product Data Submittals: For each 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.

C. Samples: For each exposed product and for each finish specified, full size.

1. Approved full-size Samples will be returned and may be used in the Work.

D. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

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1. Identify locations using room designations indicated.
- E. Delegated Design Submittals: For grab bars and shower seats.
1. Include structural design calculations indicating compliance with specified structural-performance requirements.
- 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 OWNER-FURNISHED MATERIALS
- A. Owner-Furnished Materials: Refer to Accessory Schedule on Sheet A620 for listing of product provided by Owner and installed by Contractor. These items are also included in the schedule below as OPCI.
- 2.2 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 concentrated load applied in any direction and at any point.
 2. Shower Seats: Installed units are able to resist 360 lbf concentrated load applied in any direction and at any point.
- 2.3 PUBLIC-USE WASHROOM ACCESSORIES
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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1. ASI-American Specialties, Inc.
 2. Bobrick Washroom Equipment, Inc.
 3. Bradley Corporation.
 4. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 5. Georgia Pacific.
 6. Approved substitution.
- B. Toilet Tissue (Roll) Dispenser: OPCI
1. Basis-of-Design Product: Georgia Pacific:
 - a. GP 53741 – ADA Model
 - b. GP56744.
 2. Description: Roll-in-reserve dispenser with hinged front secured with keyed lockset.
 3. Mounting: Surface mounted.
 4. Operation: Noncontrol delivery with theft-resistant spindle.
 5. Capacity: Designed for four 5-inch-diameter tissue rolls.
 6. Material and Finish: Black Plastic.
- C. Paper Towel (Folded) Dispenser: OPCI
1. Basis-of-Design Product: TORK
 2. Mounting: Surface mounted.
 3. Minimum Capacity: 2000 multifold towels.
 4. Material and Finish: Black Plastic.
 5. Lockset: Tumbler type.
- D. Waste Receptacle: CPCI
1. Basis-of-Design Product: Bobrick B-279
 2. Mounting: Surface mounted.
 3. Minimum Capacity: 6.4 Gal.
 4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 5. Liner: Reusable vinyl liner.
 6. Lockset: Tumbler type for waste receptacle.
- E. Soap Dispenser: OPCI
1. Basis-of-Design Product: GOJO 5150
 2. Description: Designed for manual operation and dispensing soap in lather form.
 3. Mounting: Vertically oriented, surface mounted.
 4. Capacity: 1250 mL.
 5. Materials: Plastic.
 6. Lockset: Tumbler type.
 7. Refill Indicator: Window type.
- F. Grab Bar: CPCI
1. Basis-of-Design Product: Bobrick B-9806 x 18, 36, 42
 2. Mounting: Flanges with concealed fasteners.
 3. Material: Stainless steel, 0.05 inch thick.

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- a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin).
 - 4. OD: 1-1/2 inches.
 - 5. Configuration and Length: As indicated on Drawings.
 - G. Sanitary-Napkin and Tampon Vendor: OPCI
 - 1. Basis-of-Design Product: EvoGen EV-1
 - 2. Mounting: Surface mounted.
 - 3. Capacity: (14) Size #4 Box Sanitary Napkins & (22) Tampons.
 - 4. Operation: TBD.
 - 5. Exposed Material and Finish: White Metal.
 - 6. Lockset: Tumbler type with separate lock and key for coin box.
 - H. Sanitary-Napkin Disposal Unit: CPCI
 - 1. Basis-of-Design Product: Bobrick B-270
 - 2. Mounting: Surface mounted.
 - 3. Door or Cover: Self-closing, disposal-opening cover.
 - 4. Receptacle: Removable.
 - 5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - I. Mirror Unit: CPCI
 - 1. Basis-of-Design Product: Bobrick B-165 2436
 - 2. Frame: Stainless steel channel.
 - a. Corners: Manufacturer's standard.
 - 3. Size: As indicated on Drawings.
 - 4. Hangers: Manufacturer's standard rigid, tamper and theft resistant.
- 2.4 CHILDCARE ACCESSORIES
- A. Source Limitations: Obtain childcare accessories from single source from single manufacturer.
 - B. Diaper-Changing Station: CPCI
 - 1. Basis-of-Design Product: Koala Kare; KB300
 - 2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support minimum 250 lb static load when opened.
 - 3. Mounting: Surface mounted, with unit projecting not more than 4 inches from wall when closed.
 - 4. Operation: By pneumatic shock-absorbing mechanism.
 - 5. Material and Finish: HDPE in manufacturer's standard color.
 - 6. Liner Dispenser: Provide built-in dispenser for disposable sanitary liners.

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2.5 UNDERLAVATORY GUARDS

A. Underlavatory Guard: CPCI

1. Basis-of-Design Product: True Bro; 102E-Z
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.6 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch-minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch-minimum nominal thickness.
- C. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- D. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- E. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.7 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

- A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

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3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800

SECTION 104413 - FIRE EXTINGUISHER CABINETS

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. Semi-Recessed Fire protection cabinets for the following:
 - a. Portable fire extinguishers.
- B. Related Sections:
 - 1. Section 104416 "Fire Extinguishers."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
 - 2. Show location of knockouts for hose valves.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For each type of fire protection cabinet indicated.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Size: 6 by 6 inches square.
- E. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function.

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1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- 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. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to fire protection cabinets including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.6 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.
- C. Coordinate sizes and locations of fire protection cabinets with wall depths.

1.7 SEQUENCING

- A. Apply vinyl lettering on field-painted, fire protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide JL Industries; Activar Construction Products Group, Inc.; Cosmopolitan Series Fire Protection Cabinet or an approved comparable product.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Stainless steel sheet.

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- 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. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- E. Cabinet Trim Material: Stainless steel sheet.
- F. Door Material: Stainless steel sheet.
- G. Door Style: Fully glazed 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 projecting door pull and friction latch.
 - 2. Provide manufacturer's standard hinge, permitting door to open 180 degrees.
- J. Accessories:
 - 1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet glazing.
 - 2) Application Process: Silk-screened.
 - 3) Lettering Color: Red.
 - 4) Orientation: Horizontal.
- K. Materials:
 - 1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304.
 - a. Finish: ASTM A480/A480M No. 4 directional satin finish,
 - 2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.2 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Provide factory-drilled mounting holes.
 - 3. Prepare doors and frames to receive locks.
 - 4. Install door locks at factory.

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- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 - 2. Fabricate door frames of one-piece construction with edges flanged.
 - 3. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.3 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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 PREPARATION

- A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
 - 1. Fire Protection Cabinets: 54 inches above finished floor to top of cabinet.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

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1. Unless otherwise indicated, provide semi-recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

C. Identification: Apply vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in 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

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SECTION 104416 - FIRE EXTINGUISHERS

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 portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Sections:
 - 1. Section 104413 "Fire Extinguisher Cabinets."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

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- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FMG.
- C. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.7 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.8 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 according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide JL Industries; Activar Construction Products Group, Inc.; Cosmic Series Fire Extinguisher or an approved comparable product.
 - a. Valves: Nickel-plated, polished brass body.
 - b. Handles and Levers: Stainless steel.
 - c. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

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2. Dry-Chemical Type: UL-rated 10-B:C, 5-lb (2.3-kg) nominal capacity, in enameled-steel container.
 - a. For general use.
3. Purple-K Dry-Chemical Type in Aluminum Container: UL-rated 30-B:C, 5-lb nominal capacity, with potassium bicarbonate-based dry chemical in enameled-aluminum container.
 - a. For use in kitchen.

2.2 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized] steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide JL Industries; Activar Construction Products Group, Inc.; Cosmopolitan Series Fire Protection Cabinet or an approved comparable product.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.

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- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

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SECTION 114000 - FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of Food Service Equipment is shown on the drawings and by schedules and equipment lists.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract documents, including General and Supplementary Conditions and Division 1- Specification sections apply to work of this section.
- B. Bidder is responsible for information and requirements located and identified on every part of the contract plans and specifications.
- C. Mechanical and Electrical Work: Refer to this project's specification sections Division 15 and Division 16, respectively, for mechanical and electrical services and connections for individual items of Food Service Equipment.

1.3 QUALITY ASSURANCE

- A. Standards:
 - 1. Except as otherwise indicated, comply with the following standards as applicable to the manufacture, fabrication and installation of the work of this section:
 - 2. NSF Standards: Comply with National Sanitation Foundation standards and criteria, and provide NSF "Seal of Approval" on each manufactured item and on major items of Custom, as per plans and details.-fabricated work.
 - 3. UL Standards: For electrical components and assemblies provide either UL labeled products or, where no labeling service is available, "recognized markings" to indicate listing in the UL "Recognized Component Index".
 - 4. ANSI Standards: For gas-burning equipment. Comply with ANSI Z21-Series standard and provide labels indicating name of testing agency. Comply with ANSI B57.1 for compressed Gas Association for compressed gas piping. Comply with ANSI A40.4 and A40.6 for water connection air gaps and vacuum breakers.
 - 5. NFPA Standards: Comply with NFPA No. 96 for exhaust systems.
 - 6. BISSC Certified: For bakery equipment
 - 7. ASME Code: Comply with ASME Boiler code requirements for steam generating and steam heated equipment; provide ASME inspection stAmps and registration with National Board.
 - 8. National Electrical Code: comply with NFPA Volume 5 for electrical wiring and devices included with Food Service Equipment, ANSI C2 and C73, and applicable NEMA and NECA standards.

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9. Seismic Restraints: Complies with SMACNA's details.
 10. Pre-installation Conference: Conduct conference at General Contractors trailer at jobsite to coordinate with all trades involved in food service equipment implementation.
- B. Manufactured Products; Fabrication: Provide standard or Custom, as per plans and details. manufactured products to comply with requirements; otherwise, shop fabricate the work to the greatest extent possible, in shops which are skilled and experienced with a minimum of three years' experience in the production of Food Service equipment.

1.4 SUBMITTALS

A. Production Data:

1. Submit (1) complete electronic set, prior to ordering and/or fabrication, of manufacturer's or shop fabricator's product information and installation instructions for each item of Food Service Equipment. For operating equipment include data on performance and operating characteristics, power/fuel consumption, rough-in dimensions and sizes, drainage requirements and similar information.
2. Submit (1) complete electronic set and (3) three sets of bound maintenance manuals, operating instructions, spare parts list, precautions against hazards, manufacturer's warranties and similar information. Distribute an additional copy of installation and start-up instructions to the installer. Mark each data sheet or brochure with the project name and applicable project equipment number(s).

B. Shop Drawings

1. Submit (1) complete electronic set of documents, prior to ordering and/or fabrication, of shop drawings showing layouts, elevations, sections and details of Custom Metal Fabricated work (work not shown by manufacturer's standard product data sheets). Show plan layouts at 1/4" scale, elevations at 1/2" scale and details at 1 1/2" or larger scales, as required.

C. Samples

1. Submit (3) samples of each exposed finish on shop-fabricated and field-fabricated Food Service Equipment. Submit 12" squares of sheet materials and 24" lengths of linear materials. Architect for color, pattern, and texture will review samples; compliance with other requirements is the exclusive responsibility of the contractor.

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1.5 PRODUCT HANDLING

- A. Protect metal finishes from damage during shipping, storage, handling, installation and construction of other work in the same space. Wrap and crate each item of equipment as needed for protection from damage. Covers exposed stainless steel surfaces with self-adhesive protective paper, of a type recommended by the metal manufacturer, and do not remove until work is installed and ready for cleaning and start-up.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metals:

1. Stainless Steel (S/S): AISI Type 302/304, hardest workable temper, No. 4 directional polish.
2. Galvanized Steel Sheet (G.I.): ASTM A526, except ASTM A527 for extensive forming; ASTM A525, G90 zinc coating, chemical treatment. Where painted finish is indicated, provide mill-phosphatized treatment in lieu of chemical treatment.
3. Steel Sheet: ASTM A 569 hot-rolled carbon steel.
4. Galvanized Steel Pipe: ASTM A53 or ASTM A120, welded or seamless, schedule 40, galvanized.
5. Steel Structure Members: Hot rolled or cold formed, carbon steel unless stainless is indicated.
6. Galvanized Finish (G.I): ASTM A123 hot-dipped zinc coating applied after fabrication.
7. Aluminum: ASTM B209/B221 sheet, plate and extrusions (as indicated); alloy, temper and finish as determined by manufacturer/fabricator, except 0.40-mil natural anodized finish on exposed work unless another finish is indicated.

B. Plastic Laminate:

1. NEMA LD3, Type 2, 0.051" thick, except Type 3, 0.042" for post-forming smooth (non-texture) white unless another texture and color is indicated or selected by Architect. Comply with NSF No. 35 where applicable.

C. Hardwood Work Surfaces:

1. Laminated edge-grained hard maple (*Acer saccharum*), NHLA First Grade with Knots, holes and other blemishes culled out, kiln dried at 8% or less moisture, waterproof glue, machined, sanded, and finished with NSF approved oil-sealer.

D. Insulation:

1. Cooled Component Insulation: Rigid, closed-cell polyurethane foam; either heat-aged slab stock for adhesive lamination with face sheets, or foamed in place using Freon 11 as expanding agent; k-value of 0.15; not less than 1.7 lbs. Per cu ft. density.

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2. Heated-Component Insulation: Rigid board, semi-rigid blanket or adhesive applied blanket of glass fiber or other mineral fiber insulation, certified by manufacturer to withstand long-term exposure to heat (temperature rating of each insulated equipment item) without deterioration. K-value of not more than 0.30; density of not less than 1.5 lbs. Per cu. Ft.

E. Joint Materials:

1. Sealant: 1-part or 2-part, polyurethane or silicone based, liquid elastomeric sealant, non-solvent release type, Shore A hardness of 30 except 45 if subject to traffic.
2. Backer Rod: Polyurethane rod stock, larger than joint width.
3. Gaskets: Solid or hollow (but not cellular) neoprene or polyvinyl chloride; light gray, minimum of 40 Shore A hardness, self-adhesive or prepared for either adhesive application or mechanical anchorage.

F. Paint and Coatings:

1. Provide the types of painting and coating materials which, after drying or curing are suitable for use in conjunction with foodservice, and which are durable, non-toxic, non-dusting, non-flaking, mildew resistant, and comply with governing regulations for Food Service.

G. Sound Deadening:

1. Heavy-bodied resinous coating, filled with granulated cork or other resilient material, compounded for permanent, non-flaking adhesion to metal in a 1/8" thick coating.
 - a. Galvanized Repair Paint: MIL-P-21035.
 - b. Pretreatment: SSPC-PT2 or PT3, or FT C490.
2. Primer Coating for Metal: FS TT-P-86 type suitable for baking where indicated.
3. Enamel for Metal: Synthetic types, FS TT-P-491, type suitable for baking where indicated.

2.2 FABRICATED PRODUCTS

A. Hardware:

1. General: Manufacturer's standard, but not less than ANSI 156.9 Type 2 (Institutional), satin finish stainless steel or dull chrome finish on brass, bronze or steel.
 - a. Cabinet Catches: Heavy-duty magnetic type, except as otherwise indicated.
 - b. Drawer Slides: Ball bearing type, side-mounting, self-closing, 250 lb. capacity.
 - c. Sliding Door Hardware: Overhead track with tandem nylon wheel hangers for door leaves over 5 sq. ft. area; roller less sanitary slides for smaller doors (comply with NSF standards).

B. Casters:

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1. Type and size as recommended by caster manufacturer, NSF approved, for the type and weight of equipment supported; but not less than 4" diameter with 15/16" tread width, with sealed self-lubricating ball bearings, cadmium-plated steel disc wheels and solid light-gray synthetic rubber tires. Provide stainless steel horns and accessories. Unless otherwise indicated, equip each item with 2 swivel-type casters and 2 fixed casters, and provide foot brakes on 2 castors on opposite corners of equipment.
 - a. Caster Bumpers: Unless equipment item is equipped with another form of all-around protective bumper provide circular rotating bumper above each caster, 5" diameter tire of light gray synthetic rubber (hollow or closed-cell) on cadmium-plated disc.
- C. Plumbing Fittings, Trim and Accessories:
 1. General: Where exposed or semi-exposed, provide bright chrome-plated brass or polished stainless steel units. Provide copper or brass where not exposed.
- D. Water Outlets:
 1. Water Fill Devices: At sinks and at other locations where water is supplied (by manual, automatic or remote control), provide commercial quality faucets, valves, dispensers or fill devices, of the type and size indicated, and as required to operate as indicated.
 2. Vacuum Breakers: Provide with Food Service Equipment where specified/required.
 3. Waste Fittings: Except as otherwise indicated, provide 2" remote-lever waste valves, and 3.5" strainer basket. Integrate unit for direct connection with waste grinder where indicated.
 4. P-Traps: Include removable P-traps where drains are indicated for direct connection to drainage system.
- E. Electrical Materials:
 1. General: Provide standard materials, devices and components as recommended by the manufacturer/fabricator, selected and installed in accordance with NEMA standards and recommendations; and as required for safe and efficient use and operation of the Food Service Equipment without objectionable noise, vibration and sanitation problems.
 - a. Controls and Signals: Provide recognized and commercial grade signals, "on-off" push button or switches, and other speed and temperature controls as required for operation, complete with pilot lights and permanent signs and graphics to assist the user of each item. Provide stainless steel cover plates at control and signal electrical boxes.
 - b. Connections: Equip each item requiring electrical power with either a terminal box for permanent connection or cord-and-plug for interruptible connection as indicated. Provide standard ground-type plugs, matching outlets (specified in Division 15), light gray (plug and cord)

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- c. Motors: Totally enclosed type, except drip-proof type where not exposed to a dust or moisture condition; ball bearings, except sleeve bearings and small timing motors; windings impregnated to resist moisture; horse-power and duty-cycle ratings as required for the service indicated.
- d. Power Characteristics: Refer to Division 16 specifications for project power characteristics. Also, refer to individual equipment requirements for loads and ratings.

2.3 FABRICATION OF METALWORK

A. General Fabrication Requirements:

1. Remove burrs from sheared edges of metalwork, ease the corners and smooth to eliminate cutting hazard. Bend sheets of metal at not less than the minimum radius required avoiding grain-separation in the metal. Maintain flat, smooth surfaces without damage to finish. Reinforce metal at locations of hardware, anchorage and accessory attachments, wherever metal is less than 14 gage or requires mortise application. Conceal reinforcements to the greatest extent possible. Weld in place on concealed faces.
2. Where fasteners are permitted, provide Phillips head, flat or oval head machine screws. Cap threads with acorn nuts unless fully concealed in inaccessible construction, and provide nuts and lock washers unless metal for tapping is at least 12 gauge. Match fastener head finish with finish of metal fastened.
3. Provide removable panels for access to mechanical and electrical service connections that are concealed behind or within foodservice equipment, but only where access is not possible and not indicated through other work.

B. Metal and Gauges:

1. Except as otherwise indicated, fabricate exposed metalwork of stainless steel; fabricate the following components from the gauge of metal indicated, and other components from not less than 20-gauge metal:
 - a. Table tops, Counter tops, Sinks, Drain-boards: 14 Gauge.
 - b. Shelves: 16 gauge, 18 gauge if less than 12" wide.
 - c. Front Drawer/Door Panels: 18 gauge (double-pan type).
 - d. Single-Pan Doors and Drawer Fronts: 16 gauge
 - e. Enclosed Base Cabinets: 18 gauge
 - f. Enclosed Wall Cabinets: 18 gauge
 - g. Exhaust Hoods: 18 gauge
 - h. Pan Type Inserts and Trays: 16 gauge
 - i. Skirts and Enclosure Panels: 18 gauge
 - j. Closure and Trim strips over 4" wide: 18 gauge
 - k. Hardware Reinforcement: 12 gauge
 - l. Gusset Plates: 10 gauge

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C. Work-Surface Fabrication:

1. Fabricate metal work surfaces by forming and welding to provide seamless construction, using welding rods matching sheet metal, grinding and polishing. Where necessary for disassembly, provide waterproof gaskets draw-type joints with concealed bolting.
2. Reinforce work-surfaces 30" o.c. both ways with galvanized or stainless concealed structural members, reinforce edges which are not self-reinforced by formed edges.
3. Sound deaden underside of metal work-surfaces, including sinks and similar units, with a coating of sound deadening material. Hold coating back 3" from sanitary edges that are open for cleaning.

D. Structural Framing:

1. Except as otherwise indicated, provide framing of minimum 1"-pipe-size round pipe or tube members, with mitered and welded joints and gusset plates, ground smooth. Provide 14 gauge stainless steel tube joints for exposed framing and galvanized steel pips for concealed framing.
2. Where indicated, flange rear and end edges up to form splashes integrally with top, with vertical and horizontal corners coved on not less than ¼" radius, die formed. Turn back splashes 1" to wall across top and ends with rounded edge on break unless otherwise specified.
3. For die-crimped edges, use inverted "V" ½" deep inside and 2" deep on outside, unless otherwise shown. For straight down flanges, make 1 ¾" deep on outside. For bull nose edges, roll down 1 ¾".
 - a. Edges: die-formed, integral with top. For rounded corners, form to 1" radius, weld, and polish to original finish.

E. Field Joints:

1. For any field joint required because of size of fixture, butt-joint, reinforce on underside with angles of same material, bolt together with non-corrosive bolts and nuts, field weld, grind and polish.

F. Pipe Bases:

1. Construct pipe bases of 1-5/8" diameter 18-gauge stainless steel tubing. Fit legs with polished stainless steel sanitary adjustable bullet feet to provide for adjustment of approximately 1 ½" without exposing tHreads.
2. Space legs to provide Ampsle support for tops, preclude any possibility of buckling or sagging and in no case more than 6'-0" centers.

G. Shelves:

1. Construct solid shelves under pipe base tables of 16-gauge stainless steel, with 1 ½" turned down and under edges, and 2" turn up at rear, against walls, welded to pipe legs.

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H. Sinks:

1. Construct sinks of 14-gauge stainless steel No. 4 finish inside and outside. Form back, bottom, front, of one piece with ends, partitions, welded into place.
2. Partitions: double thickness, 1" minimum space between walls.
3. Cove interior vertical and horizontal corners of each tub not less than ¼" radius, die formed. Outside ends of drain boards to have roll rim risers not less than 2 ½" high.
4. Drill faucet holes in splashes 2 ½" below top edge on 8" centers.
5. Weld sinks set into drain boards by 1 ½" x 14-gauge stainless steel angle brackets, securely welded to sinks and galvanized cross angles spot welded to underside of drain boards.
6. Sink Drains: Install in center of bottom of each sink bowl 1 ½" I.P.S. quick opening pop-up lever type drain approximately 4" high, with a 4 ½" flange with lugs, and fit with 3-1/8" stainless steel strainer plate.
7. Lever Handle: Of sufficient length to extend to front of sink, threaded at one end and fitted with tension spring. No riveting, screws or soldering permitted to fit drains to sinks, with all parts of drains easily removable for servicing and replacement.
8. Slope bottom of sink bowls toward outlet. Include chrome-plated tailpiece and trap.

I. Workmanship:

1. Best quality in the trade. Field verify dimensions, check measurements before fabricating; conform all items to dimensions of building; neatly fit around pipes, offsets and other obstructions.
2. Fabricate only in accordance with approved shop drawings, showing all pipes, obstructions to be built around, and location of Utility Requirements and services.
3. After the General Contractor has approved Shop Drawings, he is responsible for preventing additional obstructions being placed in way of kitchen equipment.
4. Where equipment is exposed to Custom, as per plans and details, provide enclosure of service lines, operating components and mechanical and electrical devices.

J. Enclosures:

1. Provide enclosures, including panels, housings and skirts for service lines, operating components and mechanical and electrical devices associated with the Food Service Equipment, except as specifically indicated to be "open".

K. Casework:

1. At fabricator's option, and unless otherwise indicated, provide either box-type face framing or open-channel-type (complying with NSF requirements in either case).
 - a. Enclosure: Except as otherwise indicated, provide each unit of casework (base, wall, overhead and free-standing) with a complete enclosure metal cabinet, including fronts, backs, tops, bottoms, and sides.

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- b. Door and Drawer Fronts: Except where single-pan construction is indicated, provide double-pan type, not less than 5/8" thick, with seams on inside face. Weld hardware reinforcement inside of inner pan. Sound deaden by either coating both pans on concealed face, or inserting mineral wool insulation between pans.
- c. Shelves: Except as otherwise indicated, provide adjustable standards for positioning and support of shelves in casework. Turn back-edge of shelf unit up 2" and hem. Turn other edges down to form open channel. Reinforce shelf units to support 40 lbs. per sq. ft. loading, plus 100% impact loading.
- d. Drawer Bodies: Except as otherwise indicated, draw-form drawer bodies from a single piece of metal to provide seamless construction. Flange top edge to protect slides from spillage.
- e. Closed Base: Where casework is indicated to be located on a raised-floor base, prepare casework for support without legs, and for anchorage and sealant application, as required for a completely enclosed and concealed base.
- f. Support from Floor: Equip floor-supported mobile units with casters and equip items indicated as "roll-out" units with manufacturer's standard one-directional rollers. Otherwise, and except for closed-base units, provide pipe or tube legs, with adjustable bullet-design feet for floor-supported items of fabricated metalwork. Provide 1 1/2" adjustment of feet (concealed threading).

L. Exhaust Hood Fabrication:

- 1. Comply with NFPA -96, including Appendix A.
- 2. Grease Removal: Provide type indicated (removable filters if not otherwise indicated), with drip-channel gutters, drains and collection basing.
- 3. Light Fixtures: Fluorescent fixtures, UL listed for hoods with sealed safety lenses flush with inside of hood; stainless steel conduit for wiring/or UL listed for hoods, incandescent fixtures with sealed safety lenses surface mount.
- 4. Exhaust Duct: Galvanized steel, except stainless steel where exposed to view inside the building.
- 5. Exhaust Fan: Manufacturer's standard type (complying with section 5 of NFPA-96) (see also Mech. Section).

M. Fire Extinguishing System:

- 1. Material: System is to utilize a Wet Chemical system complying with NFPA No. 17 and 96.
- 2. The bidder is responsible to submit the necessary shop drawings and submittals required by the local authorities for a review of the Fire and Life Safety requirements of the specified system(s).
- 3. Shop Drawings: The Fire Suppression System Contractor is to submit shop drawings for the fire suppression system that are to include:
 - a. The name of the Owner/Occupant.
 - b. Site address and compass orientation indication.
 - c. Installing Fire Suppression Contractor's name, address and telephone number.
 - d. Graphic representation of scale for the drawings.

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- e. Hazard analysis with sufficient detail and dimensions to evaluate the hazard. Details are to include materials involved, location and arrangement and exposure to the hazard, combustibles, air handling equipment and heat sources.
 - f. Information and calculations on the amount of suppression agent to be used.
 - g. Indicate the size, length and arrangement of connected piping or piping and hose, including all fittings.
 - h. Indicate the description and location of nozzles to be used including flow rates of nozzles for engineered systems.
 - i. Indicate with details to identify apparatus and devices to be used.
 - j. Indicate location of all alarm-initiating and alarm-signaling devices.
 - k. Indicate location and function of operating devices, auxiliary equipment and electrical circuitry if used.
 - l. Show location of annunciation panel.
 - m. Show location of power connection for fire extinguishing system as applicable including breaker number(s).
 - n. Show location of gas connection and shut off as applicable.
 - o. Identify type and location of manual activating device to operate the fire extinguishing system.
4. Certificate of Compliance: The Fire Suppression System Contractor must provide at the completion of the project, certification that the system has been installed in accordance with the approved plans and the manufacturer's listed installation and maintenance manual.
 5. Operation Instructions and As-Built Drawings: The Fire Suppression System Contractor must provide at the completion of the project, one set of manufacturer's listed installation and maintenance manuals or listed owner's manual that describes the system's operation, required maintenance and recharging to the Owner.
 6. System Alterations: When field conditions necessitate any substantial changes from the approved plans, the corrected As-Installed plans are to be prepared and submitted.
 7. Equipment List: Provide a complete equipment list for approval and before the installation of the fire alarm system identifying:
 - a. Type and model of fire extinguishing devices.
 - b. Manufacturer of fire extinguishing devices.
 - c. Manufacturer catalog data sheets for fire extinguishing devices.
 - d. Listing and capability of all equipment with the fire extinguishing system.

N. Shop Painting:

1. Clean and prepare metal surfaces to be painted; remove rust and dirt, apply treatment to zinc-coated surface that has not been mill-phosphatized. Coat welded and abraded areas of zinc-coated surfaces with galvanized repair paint. Apply 1.5 mil (dry film thickness) metal primer coating, followed by 2, 1.0 mil (dry film thickness) metal, enamel finish coatings. Bake primer and finish coatings in accordance with paint manufacturer's instructions for a baked enamel finish.

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2.4 REFRIGERATION EQUIPMENT

- A. Provide either single or multiple compressor units, as recommended by the manufacturer for the sizes and variations between connected evaporator loads as indicated.
- B. Provide units of the capacities indicated, arranged to respond to multiple-evaporator thermostats and defrosting timers. Include coils, receivers, compressors, motors, motor starters, mounting bases, vibrations insulation units, fans, dryers, valves, piping, insulation, gauges, winter control equipment, high ambient control equipment, and complete automatic control system.
- C. Refrigerant: Pre-charge units with type or types recommended by manufacturer for services indicated, with quick disconnect type connections where specified, ready to receive refrigerant piping runs to evaporators and (where remote) to condensers.
- D. Provide air-cooled condensers, located with the compressors, complete with refrigerant piping installed at the factory. Locate exterior units as shown with weather housings and protective enclosures.
- E. The minimum outdoor operating ambient temperature for design of units is -10 degrees F. Maximum ambient condition for load on the air-cooled condenser is 95 degrees F. with 75% relative humidity in basically still air, or units to be provided with high ambient temperature controls.

2.5 CARBON DIOXIDE (CO2) EQUIPMENT

- A. Where equipment requires connection with compressor CO2 cylinder for operation, provide 2-cylinders manifold and control system (integral with equipment) with proper connectors for Department of Transportation's (DOT) approved type cylinders, and complete with cylinder safety devices and supports. Comply with ANSA B57.1 "Compressed Gas Cylinder Valve Outlet and Inlet Connections", and comply with applicable standards of the Compressed Gas Association.

2.6 MISCELLANEOUS MATERIALS AND FABRICATION

- A. Nameplate:
 - 1. Wherever possible, locate nameplates and labels on manufactured items in accessible position, but not within Custom, as per plans and details. Do not apply nameplates or labels on custom fabricated work, except as required for compliance with governing regulations, insurance requirements or operator performance.
- B. Manufactured Equipment Items:
 - 1. Furnish items as scheduled or herein specified. Verify dimensions, spaces, rough in and service requirements and electrical characteristics before ordering. Provide all trim, accessories, and miscellaneous items for complete installation.

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PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

- A. The installer of the Food Service Equipment must examine the rough in of mechanical and electrical services by others, and the conditions under which the work is to be done and must verify dimensions of the services and substrates before fabricating the work. Notification of unsatisfactory conditions for the proper installation of the Food Service Equipment must be made in writing to the General Contractor.
- B. Do not proceed with the fabrication and installation until unsatisfactory dimensions and conditions have been corrected in a manner acceptable to the installer.
- C. Bidder is to verify site conditions to allow for the physical installation of each piece of equipment. Any consideration or associated cost required allowing for the installation is to be the responsibility of the bidder.

3.2 INSTALLATION

- A. Water Connections: Install water connections and outlets at each item of equipment, with air gaps, vacuum breakers and similar provisions to comply with governing regulations, but not less than compliance with ANSI Standards A40.4 and A40.6.
- B. Gas burners: Install gas burning appliances, including gas vents if necessary, to comply with NFPA No. 54.
- C. Electrical Work: Assemble electrical components of equipment in accordance with applicable "Standards of Installation" by the National Electrical Contractors Association.
- D. Service Line and Equipment Connections: Refer to division 15 sections for piping connections and piping systems. Refer to division 16 sections for electrical work including equipment connections.
- E. Jointing and Anchoring:
 - 1. Set each items of non-mobile and non-portable equipment securely in place and level and adjust to correct height. Anchor to supporting substrate where indicated and where required for sustained operation and use without shifting or dislocation. Conceal anchorage wherever possible. Adjust counter tops and other work surfaces to a level tolerance of 1/6" (maximum offset, and plus-or-minus on dimensions, and maximum variation in 2'-0" run from level of indicated slope).
 - 2. Complete field assemble joints in the work (joints which cannot be completed in the shop) by welding, bolting and gaskets, or similar methods as indicated. Grind welds smooth and restore finish. Set or trim flush, except for "T" gaskets as indicated.
 - 3. Treat enclosed spaces (inaccessible after equipment installation) by covering horizontal surfaces with powdered borax at a rate of 4 oz. per sq. ft..
 - 4. Install closure plates and strips where required, with joints coordinated with units of equipment.

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5. Install sealant and gaskets all around each unit to make joints air tight, waterproof, vermin-proof, and sanitary for cleaning purposes.
6. In general, make sealed joints not less than 1/8" wide, and stuff with backer rod to shape sealant bead properly, at 1/4" depth.
7. Shape exposed surfaces of sealant slightly concave, with edges flush with faces of material joint.
8. At internal-corner joints, apply sealant or gasket to form a sanitary cove, of not less than 3/8" radius.
9. Provide sealant-filled or gasket joints up to 3/8" joint width; metal closure strips for wider joints, with sealant application each side of strips. Anchor gaskets mechanically or with adhesives to prevent displacement.

3.3 CLEANING:

- A. After completion of installation, and completion of other major work in Food Service areas, remove protective coverings, if any, and clean Food Service Equipment, internally and externally.
- B. Restore exposed and semi-exposed finishes to remove abrasions and other damages; polish exposed-metal surfaces; touch-up painted surfaces. Replace work that cannot be successfully restored.
- C. Remove and dispose off site any and all crating and packaging material.

3.4 TESTING AND START-UP:

- A. Delay the start-up of equipment until service lines have been tested, balanced, and adjusted for pressure, voltage and similar consideration; and until water and steam lines have been cleaned and treated for sanitation.
- B. Test each item of operational equipment to demonstrate that it is operating properly, and that controls and safety devices are functioning. Repair or replace equipment that is found to be defective in its operation, including units that are below capacity or operating with excessive noise or vibration.
- C. Final Cleaning: After testing and start-up, clean and sanitize the Food Service Equipment, and leave in a condition ready for use in food service.

3.5 INSTRUCTIONS AND TRAINING:

- A. Instruct the owner and any and all representatives of the owner in the proper operation and maintenance of each piece of operational equipment.

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3.6 WARRANTY:

- A. Each item is to include a parts and labor warranty of no less than one year, and longer as standard to the manufacturer's warranty.

3.7 INSTALLATION SCHEDULE:

- A. Bidder is to review the projected construction schedule with the General Contractor prior to bidding and be able to accomplish the installation of the Food Service Equipment within the requirements of the project schedule.

3.8 BIDDING FORMAT:

- A. Bidder will provide a completed bid form for each section of work being bid, as per the General Conditions of this specification.
- B. The successful bidder will be required to submit an itemized list with individual costs for each piece of equipment included in the bid. Freight is to be included in the itemized cost for each item. Installation costs are to be itemized separately. A total amount is to be listed that includes all costs to complete the work.
- C. Change orders requested by the owner or required by job conditions to add to the equipment requirements are to be on a 'cost plus' basis. Bidder is to submit a proposal for a percentage amount that will be applied to equipment costs for all change orders.
- D. Change orders to delete equipment items will be directly related to the itemized costs breakdown provided.

3.9 DISCREPANCIES:

- A. Any discrepancies or errors located or identified in or between the specifications and plans are to be brought to the attention of the designer in writing prior to, or with the bid submittal. Any such item not identified which would cause the bid to increase, will be the responsibility of the bidder to correct.

3.10 ACCEPTABLE SUBSTITUTE MANUFACTURERS:

- A. The items listed are to be bid as specified. Manufacturers requesting to be approved as an equal substitute are to submit their request in writing to the Food Service Consultant for consideration at least (7) days prior to the bid date. Manufacturers will be considered approved and will be accepted as part of the bid only after being stated as such in writing in the form of an addendum and will be accepted only if they equally meet the specifications and standards of the specified manufacturer. A list of approved substitute manufacturers is to be submitted with the successful bidders itemized equipment list.

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- B. The bidder is solely responsible to insure that the requirements of any alternate or approved equal manufacturer's piece of equipment provided by them, comply with the design intent of these documents including physical size, utility requirements and function.

3.11 EXCLUSIONS:

- A. The Owner reserves the right to exclude any and all items from the final contract.

PART 4 - ITEMIZED LIST OF EQUIPMENT

ITEM #K-01	DRY STORAGE SHELVING
Quantity:	(1) lot
Manufacturer:	Inter Metro
Model Number:	Super Erecta, Brite
Dimensions:	(1) 60"W x 24"D x 86"H (1) 42"W x 21"D x 86"H (1) 36"W x 21"D x 86"H (1) 60"W x 14"D x 86"H
Utility Requirements:	None
Accessories:	A) Lot to include: (5) #2460BR shelves (5) #2142BR shelves (5) #2136BR shelves (5) #1360BR shelves (10) #86P posts (30) #9995Z 'S' clips
Installation Instructions:	A) Assemble, set and level as per plan. (Verify actual field dimensions for compliance.)
ITEM #K-02	REACH-IN FREEZER: TWO SECTION
Quantity:	(1) each
Manufacturer:	True
Model Number:	#STR2F-2S-HC
Dimensions:	53"W x 34"D x 84"H
Utility Requirements:	A) 115/60/1, 9.4 amp.
Accessories:	A) Self-contained air-cooled refrigeration. B) Stainless steel finish with finished sides. C) Door lock. D) Exterior thermometer. E) Set of heavy-duty locking casters. F) Kit #4 Chrome shelves on upper and lower section.
Installation Instructions:	A) Set in place as per plan.

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ITEM #K-03 REACH-IN REFRIGERATOR: TWO SECTION

Quantity: (1) each
Manufacturer: True
Model Number: #STR2R-2S-HC
Dimensions: 53"W x 34"D x 84"H
Utility Requirements: A) 115/60/1, 5.9 amp.
Accessories: A) Self-contained air-cooled refrigeration.
B) Stainless steel finish with finished sides.
C) Door lock.
D) Exterior thermometer.
E) Set of heavy-duty locking casters.
F) Kit #4 Chrome shelves on upper and lower section.
Installation Instructions: A) Set in place as per plan.

ITEM #K-04 ROLL-IN REFRIGERATOR: TWO SECTION

Quantity: (1) each
Manufacturer: True
Model Number: #STR2RR189-2S
Dimensions: 68"W x 35"D x 89"H
Utility Requirements: A) 115/60/1, 11.8 amp.
Accessories: A) Self-contained air-cooled refrigeration.
B) Stainless steel finish with finished sides.
C) Door lock.
D) Exterior thermometer.
E) Set of heavy-duty locking casters.
Installation Instructions: A) Set in place as per plan.

ITEM #K-05 SPEED RACK: MOBILE

Quantity: (4) each
Manufacturer: New Age
Model Number: #1331 PBCL
Dimensions: 21"W x 28"D x 69"H
Utility Requirements: None
Accessories: A) Perimeter bumpers.
B) (20) 18" x 26" pan capacity.
C) Set of heavy-duty locking casters.
Installation Instructions: A) Assemble and set in place as per plan.
B) Verify fit in Roll-in Refrigerator, item #K-03

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ITEM #K-06 STAINLESS STEEL TWO COMPARTMENT SINK

Quantity: (1) each
Manufacturer: Custom Metal Fabricated
Model Number: Custom, as per plans and details.
Dimensions: 6'-10"W x 30"D x 44"H
Utility Requirements: A) 1/2" Hot and cold water.
B) 1-1/2" Indirect drain.
Accessories: A) (1) each faucet knock out.
B) (2) each lever operated drain with built in overflow.
C) Two 20" x 24" sink compartments.
D) Two 21" drain boards.
E) 8" Backsplash.
Installation Instructions: A) Set and level as per plan.
B) Clip and seal back splash to wall.

ITEM #K-07 PRE-RINSE SPRAY/FAUCET

Quantity: (1) each
Manufacturer: T&S Brass
Model Number: #MPZ-8WLN-08
Dimensions: 12"W x 8"D x 22"H
Utility Requirements: A) 1/2" hot and cold water.
Accessories: A) 8" O.C. Deck mount compact pre-rinse with swing faucet.
A) 1/4 turn handles
Installation Instructions: A) Mount to back splash of Two Compartment Sink, item #K-06.

ITEM #K-08 STAINLESS STEEL WALL FLASHING

Quantity: (1) lot
Manufacturer: Custom Metal Fabricated
Model Number: Custom, as per plans and details.
Dimensions: 6'-10"W x 8'-0"H (to window sill).
Utility Requirements: None
Accessories: A) Stainless steel wall flashing on back wall at Two Compartment Sink, item #K-06, from behind base to window sill above.
B) Provide stainless steel "J" and "T" trim at seams and at top edge.
Installation Instructions: A) Mount to wall as required.

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ITEM #K-09

STAINLESS STEEL WORKTABLE

Quantity: (1) each
Manufacturer: Custom Metal Fabricated
Model Number: Custom, as per plans and details.
Dimensions: 4'-9"W x 2'-6"D x 36"H
Utility Requirements: None
Accessories: A) 8" back splash.
B) Stainless steel under shelf.
C) (2) 20" x 20" Drawer mounted at each side.
Installation Instructions: A) Set and level as per plan.
B) Clip and seal back splash to wall.

ITEM #K-10

STAINLESS STEEL WALL SHELF

Quantity: (1) each
Manufacturer: Custom Metal Fabricated
Model Number: Custom, as per plans and details.
Dimensions: 11'-9"W x 1'-2"D.
Utility Requirements: None
Accessories: A) Provide with (4) mounting brackets.
Installation Instructions: A) Mount to wall at +62" A.F.F. as per plan. Verify clearance to equipment below.
B) General Contractor to provide blocking in wall as required.

ITEM #K-11

SLICER: AUTOMATIC

Quantity: (1) each
Manufacturer: Hobart
Model Number: #HS9
Dimensions: 30"W x 24"D x 28"H
Utilities: A) 115/60/1, 5.6 amp.
Accessories: A) Removeable Knife.
B) Automatic.
Installation Instructions: A) Set in place as per plan.

ITEM #K-12

STAINLESS STEEL WORKTABLE

Quantity: (1) each
Manufacturer: Custom Metal Fabricated
Model Number: Custom, as per plans and details.
Dimensions: 6'-0"W x 2'-6"D x 36"H
Utility Requirements: None
Accessories: A) 8" back splash.
B) Stainless steel under shelf.
C) (2) 20" x 20" Drawer mounted at each side.
Installation Instructions: A) Set and level as per plan.
B) Clip and seal back splash to wall.

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ITEM #K-13 STAINLESS STEEL WALL SHELF

Quantity: (1) each
Manufacturer: Custom Metal Fabricated
Model Number: Custom, as per plans and details.
Dimensions: 6'-0"W x 1'-2"D.
Utility Requirements: None
Accessories: A) Provide with (3) mounting brackets.
Installation Instructions: A) Mount to wall at +62" A.F.F. as per plan.
B) General Contractor to provide blocking in wall as required.

ITEM #K-14 BOWL FOOD PROCESSOR

Quantity: (1) each
Manufacturer: Hobart
Model Number: #HCM61
Dimensions: 12"W x 14"D x 19" H.
Utilities: A) 120/60/1, 15.4 amp.
Accessories: A) Standard accessories.
Installation Instructions: A) Set in place as per plans.

ITEM #K-15 ICE MAKER and BIN

Quantity: (1) each
Manufacturer: Manitowoc
Model Number: #IYT0500A
Dimensions: 30"W x 24"D x 22"H (30"W x 34"D x 60"H with Bin)
Utility Requirements: A) 3/8" cold water.
B) 1/2" indirect drain to floor sink. (Ice Maker).
C) 1/2" indirect drain to floor sink. (Ice Maker).
D) 3/4" Indirect drain to floor sink. (Bin).
E) 115/60/1, 11.5 amp.
Accessories: A) Stainless steel finish.
B) 550 lb. ice production capacity per 24 hours.
C) Provide filter for incoming water.
D) Self-contained, air-cooled unit.
E) Provide ice bin #D-570. 543 lb. capacity.
Installation Instructions: A) Water pressure to be 14 to 80 psi.
B) Mount to Bin as per plan.

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ITEM #K-16 WALL MOUNT HAND SINK

Quantity: (1) each
Manufacturer: Advance
Model Number: #7-PS-50
Dimensions: 17"W x 15"D x 13"H
Utility Requirements: A) 1/2" hot and cold water.
B) 1-1/2" Direct drain.
Accessories: A) Towel and soap dispenser to be provided by owner.
B) Provide with T&S Brass #5F-4WWX03, 4" O.C. splash
mount faucet with 1/4 turn lever handles.
C) Provide with side splash at each side, as per plan.
Installation Instructions: A) Clip and seal to wall as per plan.
B) General Contractor to provide blocking in wall as required.

ITEM #K-17 KITCHEN SHELVING

Quantity: (1) lot
Manufacturer: Inter Metro
Model Number: Super Erecta, Brite
Dimensions: (2) 36"W x 18"D x 86"H
Utility Requirements: None
Accessories: A) Lot to include: (5) #1836BR shelves
(4) #86P posts
Installation Instructions: A) Assemble, set and level as per plan. (Verify actual field
dimensions for compliance.)

ITEM #K-18 TRASH CONTAINER: PROVIDED BY OWNER

Quantity (1) lot

ITEM #K-19 STAINLESS STEEL CORNER GUARDS: FULL HEIGHT

Quantity: (1) lot
Manufacturer: Custom Metal Fabricated
Model Number: Custom
Dimensions: 3" x 3" x 72"H
Utility Requirements: None
Accessories: A) Lot to include approximately (5) guard as per plan.
Installation Instructions: A) Attach to wall with glue and stainless steel screws as per plan.

ITEM #K-20 SPARE NUMBER

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ITEM #K-21

STAINLESS STEEL EXHAUST HOOD with MAKE UP AIR

- Quantity: (1) lot
- Manufacturer: AquaMatic
- Model Number: #5424-AM-ND-2-PSP-F
- Dimensions: 16'-0"W x 4'-6"D x 2'-0"H (6'-6"D at Make-up Air Plenum)
- Utilities:
- A) 120/60/1, 600 watt. Pre-wired to hood controls for lights.
 - B) Total exhaust 4400 CFM at (2) duct collars at 16"D each at 2200 CFM each at 1.048" W.C SP and 1576 duct velocity.
 - C) Total make-up air 3512 CFM at (4) duct collars at 12" x 28" each at 878 CFM each at 0.283" W.C. SP.
- Accessories:
- A) Wall canopy type unit mounted to structure above and back wall.
 - B) Hoods to be UL listed, #710, NFS Approved and built in compliance to the prevailing NFPA Standard #96.
 - C) Captrate Solo filters with hooks.
 - D) Integral 3" dead air space as required.
 - E) Provide hanger rods and seismic restraints as required.
 - F) Provide duct heat sensor assembly at each exhaust duct connections to comply with current code. Connect to control panel.
 - G) (4) Recessed round LED light fixtures and LED lights with 3500K warm output.
 - H) Stainless steel enclosure panels from hood to ceiling.
 - I) Stainless steel trim to wall behind.
 - J) Provide control panel to be recessed into adjacent wall as per plan.
 - K) System control Automan with Cashmi interface recessed in wall as per plan, with pre-wired electrical controls for fire protection system.
 - L) Full-length concealed grease drip tray below the filters pitched to an enclosed metal grease container.
 - M) Perforated front make-up air plenum.
- Installation Instructions:
- A) Mount from structure above as per plan. (866 lb.)
 - B) Mechanical Contractor to connect exhaust ducts to duct collars.
 - C) Heat Sensor to be installed by KEC and interconnected by the Electrical Contractor to the hood exhaust system as required to activate exhaust system when activated by heat.

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ITEM #K-22 FIRE PROTECTION SYSTEM

Quantity: (1) lot
Manufacturer: Ansul
Model Number: #R-102
Dimensions: -
Utility Requirements: A) Interconnect system with control panel as per electrical schematic
Accessories: A) Provide gas shut off valve and five electrical shut off contacts as required for protected equipment, for installation by mechanical and electrical contractors.
Installation Instructions: A) Provide a complete self-contained and certified system.
B) To protect Exhaust Hood, item #K-35. Tanks to be located in fire protection cabinet provided.
C) All conduits and piping to be concealed in walls and ceiling. Exposed piping in hood to be chrome.
D) Verify placement of emergency pull station with architect.
E) Gas shut off valve to be located as per plans.
F) Electrical Contractor to interconnect system with ventilation system controls as per schematic details.

ITEM #K-23 STAINLESS STEEL WALL FLASHING

Quantity: (1) lot
Manufacturer: Custom Metal Fabricated
Model Number: Custom, as per plans and details.
Dimensions: 15'-4" x 2'-10" "L" x 6'-9"H (to bottom of hood).
Utility Requirements: None
Accessories: A) Stainless steel wall flashing on back and left side cook wall from behind base to underside of hood.
C) Provide stainless steel "J" and "T" trim at seams and at top edge.
Installation Instructions: A) Mount to wall as required.

ITEM #K-24 STAINLESS STEEL UTILITY COUNTER

Quantity: (1) each
Manufacturer: Custom Metal Fabricated
Model Number: Custom, as per plans and details.
Dimensions: 4'-3"W x 3'-0" x 36"H
Utility Requirements: None
Accessories: A) 8" back splash.
B) Finished sides and cabinet base.
C) Provide with bottom and intermediate shelf.
Installation Instructions: A) Set and level as per plan.
B) Clip and seal back splash to wall.

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ITEM #K-25 STAINLESS STEEL WALL SHELF

Quantity: (1) each
Manufacturer: Custom Metal Fabricated
Model Number: Custom, as per plans and details.
Dimensions: 4'-3"W x 1'-2"D.
Utility Requirements: None
Accessories: A) Provide with (2) mounting brackets.
Installation Instructions: A) Mount to wall at +62" A.F.F. as per plan. Verify mounting height to clear equipment on counter below.
B) General Contractor to provide blocking in wall as required.

ITEM #K-26 COMBI STEAMER/OVEN

Quantity: (1) each
Manufacturer: UNOX
Model Number: #XACC-0513-EPRM
Dimensions: 22"W x 35"D x 26"H
Utility Requirements: A) 208/60/1, 22.7 Amps.
B) 3/4" treated cold water. 22 to 87 psi. Provide flexible connection to allow for movement of oven.
C) 1" indirect copper drain to floor sink.
Accessories: A) Standard hand door hinge.
B) Auto-clean, Self-clean.
C) Certified Installation.
D) Certified Chef training
E) Installation Kit
F) Water filter to meet quality treated water standards required.
G) Provide Watts Series LF7R Dual Check Valve (or equivalent) back flow preventers as required by code for installation by plumbing contractor.
Installation Instructions: A) Set in place on counter and level as per plan.
B) Rough-in connection to be quick disconnect.
C) Adjust for local altitude as required.
D) Plumbing Contractor to provide water connections and copper drain connection.

ITEM #K-27 COUNTER TOP PASTA COOKER

Quantity: (1) each
Manufacturer: Arcobaleno
Model Number: #APCTXACC-0513-EPRM
Dimensions: 22"W x 35"D x 26"H
Utility Requirements: A) 230/60/1, 27.17 amp.
Accessories: A) Verify pasta basket options with owner.
Installation Instructions: A) Set in place on counter and level as per plan.
B) Rough-in connection to be quick disconnect.

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ITEM #K-28 REFRIGERATED CHEF'S BASE

Quantity: (1) each
Manufacturer: True
Model Number: #TRCB-48-HC
Dimensions: 4'-0"W x 33"D x 26"H.
Utility Requirements: A) 115/60/1, 2.4 amp.
Accessories: A) Stainless steel finish with flat top.
B) Self-contained air-cooled refrigeration.
C) (2) Drawer base.
D) Finished stainless steel ends.
Installation Instructions: A) Set in place as per plan.

ITEM #K-29 OPEN FACE BROILER

Quantity: (1) each
Manufacturer: Vulcan
Model Number: #VCCB47
Dimensions: 47"W x 33"D x 12"H
Utility Requirements: A) 3/4" natural gas, 116,000 BTU/Hr
Accessories: A) Provide 48" Quick disconnect flexible hose gas connection with wall tether.
B) Provide leak limiter gas pressure regulator as required.
Installation Instructions: A) Set in place on Chef's Base, item #K-28, as per plans and details.
B) Rough-in connection to be quick disconnect.
C) Adjust for local altitude and environmental conditions as required.

ITEM #K-30 EIGHT BURNER RANGE with STANDARD OVEN BASE

Quantity: (1) each
Manufacturer: Vulcan
Model Number: #48SS-8BN
Dimensions: 48"W x 34"D x 37"H
Utility Requirements: A) 3/4" natural gas, 286,000 BTU/Hr.
Accessories: A) Stainless steel sides.
B) Set of heavy duty locking casters.
C) 10" Stainless steel stub back.
D) Flame safety device with manual spark ignition.
E) 48" Quick disconnect flexible hose gas connection with wall tether.
F) Provide leak limiter pressure regulator as required.
Installation Instructions: A) Set in place on Chef's Base, item #K-48, and level as per plan.
B) Utility connection to be quick disconnect.
C) Adjust for local altitude as required.

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ITEM #K-31 WALL MOUNT RADIANT BROILER

Quantity: (1) each
Manufacturer: Southbend
Model Number: #P48-RAD
Dimensions: 48"W x 16"D x 22"H
Utility Requirements: A) 3/4" natural gas, 60,000 BTU/Hr
Accessories: A) Provide leak limiter pressure regulator as required.
B) Provide with wall mounting brackets.
Installation Instructions: A) Mount to wall as per plans.

ITEM #K-32 STAINLESS STEEL LANDING TABLE: MOBILE

Quantity: (1) each
Manufacturer: Custom Metal Fabricator.
Model Number: Custom, as per plans and details.
Dimensions: 1'-3"W x 36"D x 36"H
Utility Requirements: None.
Accessories: A) Flat top.
B) Stainless steel undershelf.
C) Set of heavy duty casters with locks.
Installation Instructions: A) Set in place as per plan.

ITEM #K-33 FRY SYSTEM

Quantity: (1) lot
Manufacturer: Dean
Model Number: #SR42G
Dimensions: 16"W x 30"D x 35"H (45"H to top of flue)
Utility Requirements: A) 3/4" Natural Gas, 105,000 BTU/Hr.
Accessories: A) Casters, 2 with locks.
B) Twin baskets.
C) Stainless steel finish.
D) Touch screen Computer controls.
E) Stainless steel pot.
F) Tank covers.
G) 48" Quick disconnect flexible hose gas connection with wall tether.
H) Provide leak limiter pressure regulator as required.
Installation Instructions: A) Set in place as per plans.
B) Rough-in connection to be quick disconnect.
C) Adjust for local altitude and environmental conditions as required

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ITEM #K-34 ROTARY PIZZA OVEN

Quantity: (1) each
 Manufacturer: Wood Stone
 Model Number: WS-RV
 Dimensions: 78"W x 80"D x 77"H (82"H to top of flue)
 Utility Requirements: A) 1" Natural Gas, 300,000 BTU/Hr
 B) 120/60/1, 3.2 amp.
 B) 12" round flue collar to power ventilated, grease-rated chimney rated exhaust duct and fan.
 Accessories: A) Hi temperature thermostat.
 B) Provide leak limiter pressure regulator as required.
 Installation Instructions: A) Set in place as per plans during construction so that unit can be built-in as per architectural details. 3,200 lbs.
 B) Coordinate installation requirements with General Contractor.
 C) Adjust for local altitude and environmental conditions as required.

ITEM #K-35 EXHAUST FLUE WITH FAN: PROVIDED BY MECHANICAL SYSTEM

Quantity (1) lot

ITEM #K-36 REFRIGERATED PIZZA TABLE

Quantity: (1) each
 Manufacturer: True
 Model Number: #TPP-AT-60D-2-HC
 Dimensions: 45"W x 34"D x 45"H
 Utility Requirements: A) 115/60/1, 3.9 amp.
 Accessories: A) Air cooled self-contained refrigeration
 B) Provide with locking casters.
 C) Provide with stainless steel lid cover.
 D) Two drawers, one door.
 Installation Instructions: A) Set in place as per plan.

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ITEM #K-37 STAINLESS STEEL WORK COUNTER

Quantity: (1) lot
Manufacturer: Custom Metal Fabricated
Model Number: Custom, as per plans and details.
Dimensions: 8'-11"W x 3'-0"D x 3'-0"H. Verify with field measurements.
Utility Requirements: None
Accessories: A) Stainless steel bottom and intermediate shelf.
B) Stainless steel bottom shelf with apron at Utility Sink, item #K-38.
C) Provide for the installation of Undercounter Warming Cabinet with Drawers, item #K-39.
D) Stainless steel bottom shelf with apron at Drop-in Food Warmer, item #K-42.
E) Open base to install Undercounter Freezer, item #K-41.
F) Stainless steel top.
G) Finished sides.
H) Stainless steel adjustable bullet feet on steel frame.
I) Full width removeable 8"D cutting board
Installation Instructions: A) Set and level as per plan.

ITEM #K-38 STAINLESS STEEL UTILITY SINK

Quantity: (1) each
Manufacturer: Custom Metal Fabricated
Model Number: Custom, as per plans and details.
Dimensions: 12"W x 18"D x 10"H.
Utility Requirements: A) 1/2" Cold water.
B) 1-1/2" indirect drain to floor sink.
Accessories: A) Heavy duty deck mounted faucet 4" O.C.
B) Includes drain assembly.
Installation Instructions: A) Weld integral into Work Counter, item #K-37, as per plan.

ITEM #K-39 UNDERCOUNTER WARMING CABINET with DRAWERS

Quantity: (1) each
Manufacturer: Winston
Model Number: #HBB0D2
Dimensions: 24"W x 30"D x 26"H
Utility Requirements: A) 120/60/1, 12 amp.
Accessories: A) Timer.
B) Full steam pan drawer.
Installation Instructions: A) Build into Work Counter, item #K-37, as per plan.

ITEM #K-40 SPARE NUMBER

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ITEM #K-41 UNDERCOUNTER FREEZER

Quantity: (1) each
Manufacturer: True
Model Number: #TUC-27F-ADA-HC
Dimensions: 28"W x 31"D x 34"H
Utility Requirements: A) 115/60/1, 2.3 amp.
Accessories: A) Stainless steel finish.
B) Self-contained, air-cooled refrigeration.
C) Set of heavy-duty ADA locking casters.
Installation Instructions: A) Set in place as per plan.

ITEM #K-42 DROP-IN HOT FOOD PAN: TWO PAN

Quantity: (1) each
Manufacturer: Hatco
Model Number: #HWBI-2M
Dimensions: 30"W x 24"D x 10"H
Utility Requirements: A) 1" Indirect drain to floor sink.
B) 208/60/1, 11.6 amp.
Accessories: A) Individually heated compartments.
B) (2) Full size hotel pan capacity.
C) Controls to be mounted in counter apron.
D) Provide ventilation at base of Serving Counter, item #K-61 as required.
E) Wet or dry operation per compartment.
F) Provide with code compliant auto water fill feature.
G) Drop-in units to have rollover water fill to each adjacent compartment.
H) 1" Copper manifold drain with bottom center drain with easily accessible 1" high temperature NPT quarter turn ball valve.
Installation Instructions: A) Build into Work Counter, item #K-37, as per plan.

ITEM #K-43 ROTARY TOASTER

Quantity: (1) each
Manufacturer: Hatco
Model Number: #TQ3-900H
Dimensions: 15"W x 18"D x 15"H
Utility Requirements: A) 208/60/1, 14.5 Amp.
Accessories: A) Cord and plug.
B) Auto power save mode
Installation Instructions: A) Set in place on Utility Counter, item #S-2, as per plans.

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ITEM #K-44 MICROWAVE OVEN

Quantity: (1) each
Manufacturer: Panasonic
Model Number: #NE-12521
Dimensions: 17"W x 20"D x 14"H
Utilities: A) 120/60/1, 17.7 amp.
Accessories: A) Standard features.
Installation Notes: A) Set in place on top pass shelf as per plan.

ITEM #K-45 REFRIGERATED FOOD PREP TABLE

Quantity: (1) each
Manufacturer: True
Model Number: #TSSU-48-18M-B-HC
Dimensions: 49"W x 34"D x 36"H (52"H with lid open.)
Utility Requirements: A) 115/60/1, 5.8 amp.
Accessories: A) Stainless steel finish.
B) Self-contained, air cooled refrigeration.
C) (18) 1/6 pan insert top configuration.
D) Set of locking casters.
Installation Instructions: A) Set in place as per plan.

ITEM #K-46 PENDANT HEAT LAMPS

Quantity: (12) each
Manufacturer: Hatco
Model #: #DLH-600-R-R
Dimensions: 8"D x 9"H
Utility Requirements: A) 120/60/1, 375 watts.
Accessories: A) Ceiling R Mount black adjustable cord.
B) High wattage.
C) Shade style and finish as per architect's selections.
D) Clear coated bulb.
Installation Instructions: A) Mount from ceiling with adjustable cord. Interconnect to wall mount switches as per plan.

ITEM #K-47 SPARE NUMBER

ITEM #K-48 SPARE NUMBER

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ITEM #K-52 BAR SODA GUN DISPENSING SYSTEM: PROVIDED BY VENDER

Quantity: (1) system
Manufacturer: Verify with Vender
Model Number: As per Vender
Dimensions: Verify with Vender
Utility Requirements: Verify Utility Requirements with Vender
A) 1/2" cold water
B) 120/60/1, 2 amp., Gun
C) 120/60/1, 10 amp, Carbonator
D) 1/2" indirect drain to floor sink.
Accessories: Verify all requirements with vender.
A) Provide (8) Button gun carbonated gun, with 90 degree fitting.
B) Provide carbonator, mounted below cocktail station.
C) Provide gun holder/drain, drain line and hose fittings.
Installation Instructions: Verify all requirements with vender.
A) Vender to mount to bar as per plan.
B) Vender to connect to syrup lines from chase to remote syrup racks in level above.

ITEM #K-52A SODA/SYRUP RACK & CO2 TANKS: PROVIDED BY VENDER

Quantity: (1) each
Manufacturer: By Vender
Model Number: Verify with Vender
Dimensions: Verify with Vender
24"W x 18"D x 30"H
Utility Requirements: None
Accessories: As per Vender
Installation Instructions: A) Vender to set in place as per plan.
B) Interconnect soda lines to Soda Gun Dispenser, item #K-52 from syrup boxes.
C) General Contractor to provide chase to soda dispenser.
D) Verify all requirements with Vender.

ITEM #K-52B SODA/SYRUP RACK & CO2 TANKS: PROVIDED BY VENDER

Quantity: (1) each
Manufacturer: By Vender
Model Number: Verify with Vender
Dimensions: Verify with Vender
6"D x 27"H
Utility Requirements: None
Accessories: As per Vender
Installation Instructions: A) Vender to set in place as per plan.
B) Interconnect CO2 to Soda Gun Dispenser, item #K-52 from tank location.
C) General Contractor to provide chase to soda dispenser.
D) Verify all requirements with Vender.

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ITEM #K-53

BAR DRAINBOARD

Quantity: (1) each
Manufacturer: Perlick
Model Number: #SC-24
Dimensions: 24"W x 24"D x 30"H (36"H to top of back splash)
Utility Requirements: A) 1-1/2" indirect drain to floor sink.
Accessories: A) Stainless steel finished ends when not adjacent to another unit, as per plan.
B) Open front with bottom shelf and adjustable intermediate shelf.
Installation Instructions: A) Set and level as per plan.
B) Assemble with items #K-51, #K-54 & #K-55, for a single assembly.

ITEM #K-54

BAR HAND SINK

Quantity: (1) each
Manufacturer: Perlick
Model Number: #TSD12HSN
Dimensions: 12"W x 23"D x 30"H (36"H to top of back splash)
Utility Requirements: A) 1/2" hot and cold water.
B) 1-1/2" indirect drain to floor sink.
Accessories: A) Stainless steel finished right end as per plan.
B) Folded paper towel dispenser.
C) Soap dispenser assembly.
D) Splash mounted faucet.
Installation Instructions: A) Set and level as per plan.
C) Assemble with items #K-51, #K-53 & #K-55, for a single assembly.

ITEM #K-55

BAR DRY WASTE CABINET

Quantity: (1) each
Manufacturer: Perlick
Model Number: #TS12TRA
Dimensions: 12"W x 24"D x 30"H (36"H to top of back splash)
Utility Requirements: None.
Accessories: A) Stainless steel finished ends as per plan.
Installation Instructions: A) Set and level as per plan.
B) Assemble unit with item K-51, #K-54 & #K-55, for a single assembly.

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ITEM #K-56 REFRIGERATED BACK BAR

Quantity: (2) each
Manufacturer: Perlick
Model Number: #BBS60
Dimensions: 60"W x 24-3/4"D x 34-1/2"H
Utility Requirements: A) 115/60/1, 5.5 amp.
Accessories: A) Door lock.
B) Laminate finish as per Interior Design selection.
C) Compressor on left and right, as per plan.
D) All doors hinged as per plan.
E) Beer temperature (34-42F)
F) Provide one section with (6) wine shelves.
Installation Instructions: A) Install into back bar as per plan. Coordinate requirements with supplier/manufacturer of back bar cabinet.

ITEM #K-57 SERVE/SELF-SERVICE ADJUSTABLE FOOD GUARD/DISPLAY SHELF

Quantity: (1) each
Manufacturer: BSI
Model Number: XGuard #XG3930
Dimensions: 14'-6"W x 18"D x 1'-10"H. Verify with field measurements.
Utility Requirements: None
Accessories: A) Three dimension adjustable self-serve food shield. (2) 5'-3"W sections and (1) 4'-0" section with stainless steel finish at drop-in soup warmer and drop-in refrigerated cold pans, as per plans and details.
B) Stainless steel below counter heavy-duty flange supports mounted through counter top to base counter structure.
C) 1/2" glass with radius corners.
Installation Instructions: A) Build onto Service Counters, item #K-MK-05.

ITEM #K-58 DROP-IN REFRIGERATED COLD FOOD PAN: FOUR PAN

Quantity: (2) each
Manufacturer: Hatco
Model Number: #CWB-4
Dimensions: 58"W x 27"D x 26"H
Utility Requirements: A) 1" Indirect drain to floor sink.
B) 120/60/1, 5.9 amp.
Accessories: A) Self-contained, air-cooled refrigeration.
B) (4) Full size hotel pan capacity.
C) Controls to be mounted in counter apron.
D) Provide ventilation at base of Salad Bar Counter, item #MK-5 as required.
Installation Instructions: A) Build into Salad Bar Counter, item #MK-5, as per plan.

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ITEM #K-59 SOUP WARMER

Quantity: (3) each
Manufacturer: Hatco
Model Number: #HWBHI-11QTD
Dimensions: 13" Diameter x 9"H
Utility Requirements: A) 3/4" indirect drain to floor sink.
B) 208/60/1, 3.4 amp.
Accessories: A) Individual thermostat control.
B) Drain kit.
C) Fully insulated.
Installation Instructions: A) Build into Salad Bar Counter, item #MK-5, Chef's Counter, item #K-42, as per plans.
B) Mount controls to apron of serving counter.

ITEM #K-60 STAINLESS STEEL SALAD BAR BASE COUNTER

Quantity: (1) lot
Manufacturer: Custom Metal Fabricated
Model Number: Custom, as per plans and details.
Dimensions: 16'-6"W x 2'-10"D x 2'-10"H*. (*Finished height). Verify with field measurements.
Utility Requirements: None
Accessories: A) Stainless steel bottom shelf with apron.
B) Stainless steel top.
C) Finished sides.
D) Stainless steel adjustable bullet feet on steel frame.
E) Set counter against front Salad Bar Counter, item #MK-05. Salad Bar Counter, #K-70, front cabinet base.
F) Stone top to be set on top of base counter.
Installation Instructions: A) Set and level as per plan.
B) Coordinate requirements with fabricator of front counter and stone top.

ITEM #K-61 UNDER COUNTER REFRIGERATOR

Quantity: (2) each
Manufacturer: True
Model Number: #TUC-48-ADA-HC
Dimensions: 48"W x 30"D x 34"H
Utility Requirements: A) 115/60/1, 3 amp.
Accessories: A) Stainless steel finish.
B) Self-contained air-cooled refrigeration.
C) Provide with adjustable feet.
D) Two swing door base.
Installation Instructions: A) Set in place in base of Salad Bar Back Support Counter, item #MK-6, as per plan. (Verify fit).

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ITEM #K-62 UNDERCOUNTER WARMING CABINET with DRAWERS

Quantity: (3) each
Manufacturer: Winston
Model Number: #HBB0D2
Dimensions: 24"W x 30"D x 26"H
Utility Requirements: A) 120/60/1, 12 amp.
Accessories: A) Timer.
 B) Full steam pan drawer.
Installation Instructions: A) Set in place in base of Salad Bar Back Support Counter, item
 #MK-6, as per plan. (Verify fit).

ITEM #E-01 POS REGISTER: PROVIDED BY OWNER

Quantity: (2) each

ITEM #E-03 POS SCREEN PRINTER: PROVIDED BY OWNER

Quantity: (3) each

END OF SECTION 114000

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SECTION 115213 - PROJECTION SCREENS

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. Manually operated, front-projection screens.
- 2. Electrically operated, front-projection screens.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for metal support framing for front-projection screens.
- 2. Section 061053 "Miscellaneous Rough Carpentry" for wood backing for screen installation.

1.3 DEFINITIONS

- A. ALR: Ambient-light rejection; for specular reflective viewing surfaces, measured as the percentage of ambient light striking the viewing surface that has equal angles of incidence and reflection.
- B. Gain: Ratio of light reflected from viewing-surface material to that reflected perpendicularly from a magnesium carbonate surface as determined in accordance with SMPTE RP 94.
- C. Half-Gain Angle: The angle, measured from the axis of the viewing surface to the most central position on a perpendicular plane through the horizontal centerline of the viewing surface, where the gain is half of the peak gain.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show layouts and types of front-projection screens. Include the following:
 - 1. Drop heights.
 - 2. Location of seams in viewing surfaces.

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3. For end-mounted motors, location of screen centerline relative to ends of screen case.
 4. Anchorage details, including connection to supporting structure for suspended units.
 5. Details of juncture of screen case or trim with adjacent finishes.
 6. For electrically operated units, wiring diagrams and location of wiring connections.
 7. Accessories.
- C. Samples: For each type of exposed finish and for each color and finish specified, in manufacturer's standard sizes.
- D. Product Schedule: For front-projection screens.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For front-projection screens to include in maintenance manuals.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Environmental Limitations: Do not deliver front-projection screens until spaces are enclosed and weathertight, wet-work in installation spaces is complete and dry, and temporary or permanent HVAC system is operating and maintaining ambient temperature and humidity conditions planned for building occupants during the remainder of the construction period.
- B. Store front-projection screens in manufacturer's protective packaging and according to manufacturer's written instructions.
- 1.7 COORDINATION
- A. Coordinate layout and installation of front-projection screens with adjacent construction, including ceiling suspension systems, light fixtures, HVAC system components, fire-suppression system, and partitions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Projection Screens: Obtain front-projection screens from single manufacturer. Obtain viewing surfaces and accessories, including mounting hardware, from screen manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Viewing-Surface and Masking Materials:

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1. Mildew-Resistance Rating: Zero or 1 when tested in accordance with ASTM G21.
2. Flame Resistance: Passes NFPA 701.
3. Flame-Spread Index: Not greater than 75 when tested in accordance with ASTM E84.

2.3 ELECTRICALLY OPERATED, FRONT-PROJECTION SCREENS

- A. General Requirements: Manufacturer's standard units, consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by Underwriters Laboratories Inc. (UL) or another testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a metal rod, with ends of rod protected by plastic caps.
- B. Surface-Mounted, Metal-Encased, Electrically Operated Screen: Motor-in-roller unit with screen case fabricated from formed-steel sheet or from aluminum extrusions with manufacturer's standard finish and matching end caps.
 1. Basis-Of-Design Product: Subject to compliance with requirements, provide Draper Inc.; Premier or an approved substitution meeting the requirements herein.
 2. Motor in Roller: Instant-reversing motor of size and capacity recommended in writing by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.
 3. Controls: Remote, three-position control switch installed in recessed device box with flush cover plate matching other electrical device cover plates in room where switch is installed.
 - a. Provide with two control switches.
 - b. Provide power supply for low-voltage systems if required.
 - c. Provide video interface control for connecting to projector. Projector provides signal to raise or lower screen.
 4. Surface-Mounting Configuration: Mounted directly to wall or ceiling, as indicated on Drawings, with concealed mounting.
 5. Screen-Case Color: As selected by Architect from manufacturer's standard options.
 6. Tab-Tensioned, High-Contrast-Gray Viewing Surface: Minimum peak gain of 0.8 and 45-degree minimum half-gain angle, with black backing.

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- a. Tab Tensioning: Durable low-stretch cord, such as braided polyester, on each side of screen that is connected to edge of entire height of screen by tabs, to pull viewing surface flat horizontally.
- 7. Size of Viewing Surface: As indicated in schedule on Drawings.
- 8. Extra Drop Height: As indicated in schedule on Drawings.
 - a. Color: Same as viewing surface.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install front-projection screens at locations indicated on Drawings to comply with screen manufacturer's written instructions.
- B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor them to supporting substrate in a manner that produces a smoothly operating screen that, when lowered, has flat viewing surface and plumb vertical edges.
 - 1. Install low-voltage controls in accordance with NFPA 70 and complying with manufacturer's written instructions.
 - a. Wiring Method: Install wiring in raceway, except in accessible ceiling spaces and in gypsum board partitions, where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables, except in unfinished spaces.
 - 2. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.
 - 3. Test manually operated units to verify that screen-operating components are in optimum functioning condition.

END OF SECTION 115213

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motor-operated, double-roller shades.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

D. Product Schedule: For roller shades.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material.

C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

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1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain roller shades from single source from single manufacturer.

2.2 MOTOR-OPERATED, DOUBLE-ROLLER SHADES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Draper Inc.
- 2. Hunter Douglas Contract.
- 3. Levolor.
- 4. Lutron Electronics Co., Inc.
- 5. MechoShade Systems, Inc.
- 6. Approved substitution.

- B. Motorized Operating Systems: Provide factory-assembled, shade-operator systems of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

- 1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 2. Electric Motor: Manufacturer's standard tubular, enclosed in rollers.
 - a. Electrical Characteristics: 110-V ac.
 - b. Maximum Total Shade Width: As required to operate roller shades indicated.
 - c. Maximum Shade Drop: As required to operate roller shades indicated.
 - d. Maximum Weight Capacity: As required to operate roller shades indicated.
- 3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:
 - a. Infrared Control: System consisting of concealed receiver complete with external eye and connecting modular cable and two portable, multiple-channel transmitters with separate buttons to open and close individual or groups of shades, to open and close shades simultaneously, and to stop shade movement.
 - 1) Capacity: Up to 12 individual or groups of shades.
 - b. Timer Control: Clock timer, seven-day programmable for regular events.
 - c. Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features; isolated from voltage spikes and surges.

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- d. Color: As selected by Architect from manufacturer's full range.
- 4. Crank-Operator Override: Crank and gearbox operate shades in event of power outage or motor failure.
- 5. Limit Switches: Adjustable switches, interlocked with motor controls and set to stop shade movement automatically at fully raised and fully lowered positions.
- 6. Operating Features:
 - a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
 - b. Capable of interface with multiroom control system.
 - c. Capable of accepting input from building automation control system.
 - d. Override switch.
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shades for service.
 - 1. Double-Roller Mounting Configuration: Offset, outside shade over and inside shade under.
 - 2. Inside Roller:
 - a. Drive-End Location: Right side of interior face of shade.
 - b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
 - 3. Outside Roller:
 - a. Drive-End Location: Right side of interior face of shade.
 - b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
 - 4. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.
- E. Inside Shadebands:
 - 1. Shadeband Material: Light-filtering fabric.
 - 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Exposed with endcaps.
 - b. Color and Finish: As selected by Architect from manufacturer's full range.
- F. Outside Shadebands:
 - 1. Shadeband Material: Light-blocking fabric.
 - 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Exposed with endcaps.

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- b. Color and Finish: As selected by Architect from manufacturer's full range.

G. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 - a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.
2. Endcap Covers: To cover exposed endcaps.
3. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
 - a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches.
 - b. Provide pocket with lip at lower edge to support acoustical ceiling panel.
4. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recesses or pockets and for snap-in attachment to wall clip without fasteners.
 - a. Closure-Panel Width: 2 inches.
5. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
6. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
7. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 1. Source: Roller shade manufacturer.
 2. Type: PVC-coated polyester.
 3. Weave: Mesh or Basketweave.
 4. Thickness: 0.026 inches minimum.
 5. Weight: 13 oz./sq. yd. minimum.
 6. Roll Width: As required to meet window width up to 84 inches.
 7. Orientation on Shadeband: Railroaded.
 8. Openness Factor: 3 percent.
 9. Color: As selected by Architect from manufacturer's full range.

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- C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.
 - 1. Source: Roller shade manufacturer.
 - 2. Type: Polyester with foamed-acrylic backing.
 - 3. Thickness: 0.026 inches minimum.
 - 4. Weight: Weight: 13 oz./sq. yd. minimum.
 - 5. Roll Width: As required to meet window width up to 84 inches.
 - 6. Orientation on Shadeband: Railroaded.
 - 7. Features: Antistatic treatment.
 - 8. Color: As selected by Architect from manufacturer's full range.

2.4 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
 - 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
 - 1. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

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1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.
- B. Electrical Connections: Connect motor-operated roller shades to building electrical system.
- C. Roller Shade Locations: At exterior windows.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 122413

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SECTION 123661.19 - QUARTZ AGGLOMERATE COUNTERTOPS

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. Quartz agglomerate countertops.
2. Quartz agglomerate back and end splashes.
3. Quartz agglomerate apron fronts.

B. Related Requirements:

1. Section 017419 "Construction Waste Management and Disposal."
2. Section 055000 "Metal Fabrications" for supports for countertops.
3. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
4. Section 064116 "Plastic-Laminate-Clad Architectural Cabinets" for installing cabinets.
5. Section 220400 "Plumbing Systems" for sinks and plumbing fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Initial Selection: For each type of material exposed to view.

D. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.
2. Wood trim, 8 inches long.
3. One full-size quartz agglomerate countertop, with front edge and backsplash, 8 by 10 inches of construction and in configuration specified.

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1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Build mockup of typical countertop as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.
 - 1. Q1 - Basis of Design Product: Subject to compliance with requirements, provide Daltile; One Quartz Surfaces or a comparable substitute product as approved by Architect.
 - a. Colors and Patterns: As indicated on finish schedule. See sheet AE620.

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2. Q2 - Basis of Design Product: Subject to compliance with requirements, provide Crossville Studios; Suggar or a comparable substitute product as approved by Architect.

- a. Colors and Patterns: As indicated on finish schedule. See sheet AE620.

- B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.

- C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom.

- B. Configuration:

1. Front: Straight, slightly eased at top.
 2. Backsplash: Straight, slightly eased at corner.
 3. End Splash: Matching backsplash.

- C. Countertops: 1/2-inch-thick, quartz agglomerate with front edge built up with same material.

- D. Backsplashes: 1/2-inch-thick, quartz agglomerate.

- E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

- F. Joints: Fabricate restroom countertops without joints.

- G. Joints: Fabricate countertops in sections for joining in field.

1. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
 2. Joint Type: Sealant filled, 1/16 inch in width.
 3. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.

- H. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

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- a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by quartz agglomerate manufacturer.
 1. Verify adhesives have a VOC content of 70 g/L or less.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive quartz agglomerate 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 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's

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written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

- E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
 - 1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
 - 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Pre-drill holes for screws as recommended by manufacturer.
- H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
 - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- I. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.19

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SECTION 21 1000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following fire-suppression piping inside the building:
 - 1. Wet-pipe sprinkler systems.
 - 2. Description: Move sprinklers for new layout with existing system.
- B. Related Sections include the following:
 - 1. Division 10 Section "Fire Extinguisher Cabinets" and "Fire Extinguishers" for cabinets and fire extinguishers.
 - 2. Division 22 Section "Facility Water Distribution Piping" for piping outside the building.
 - 3. Division 28 Section "Fire Detection and Alarm" for alarm devices not specified in this Section.
- C. All black steel sprinkler pipe shall have a wall thickness equal to schedule 40.
 - 1. Exception: Pipe with a nominal pipe size of 6 inches and greater may be schedule 10.

D. Summary Table:

Item	Summary	ref
Underground service entrance piping	Existing to remain	22,34E,3.6B,3.8D
Interior pipe type	Mains: Schedule 40 Branchlines: Threadable thinwall or schedule 40	23.2
Sprinkler Finish	Flat Plate Concealed, except uprights and storage	3.11,3.12
Extended Coverage	Not Allowed	3.11A
Center of Tile	Required, Center thirds are acceptable for rectangular tiles	
Flexible Sprinkler Drops	Designers' preference	29
FM Global	No	Green Highlights
Calculations	No	1.5D,3.1
Alarm Device	Existing to remain	2.19.B

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FDC	Existing to remain	
Coordination	All sprinkler piping exposed to view shall be coordinated with the architect prior to final design acceptance.	

1.3 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride plastic.
- B. CR: Chlorosulfonated polyethylene synthetic rubber.
- C. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.
- D. PE: Polyethylene plastic.
- E. Underground Service-Entrance Piping: Underground service piping below the building.

1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. High-Pressure Piping System Component Working Pressure: Listed for 250 psig minimum 300 psig.
- C. Design sprinkler piping according to the following and obtain approval from engineer, prior to submitting to other authorities having jurisdiction:
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. Automobile Parking Areas: Ordinary Hazard, Group 1.
 - b. Building Service Areas: Ordinary Hazard, Group 1.
 - c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - d. General Storage Areas: Ordinary Hazard, Group 1.
 - e. Laundries: Ordinary Hazard, Group 1.
 - f. Libraries, Except Stack Areas: Light Hazard.
 - g. Library Stack Areas: Ordinary Hazard, Group 2.

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- h. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - i. Office and Public Areas: Light Hazard.
 - j. Residential Living Areas: Light Hazard.
 - k. Restaurant Service Areas: Ordinary Hazard, Group 1.
 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
 - d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
 - e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
 - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
 4. Maximum Protection Area per Sprinkler: Per UL listing.
 5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
 6. Sprinklers are to be installed throughout the premises, as required by NFPA 13.
- D. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13.

1.6 SUBMITTALS

- A. Product Data: For the following:
 1. Piping materials, including dielectric fittings, flexible connections, and sprinkler specialty fittings.
 2. Pipe hangers and supports, including seismic restraints.
 3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
 4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
 5. Alarm devices, including electrical data.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Fire-hydrant flow test report.
- D. Seismic Calculations.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable. Drawings are to be approved by Engineer prior to submission to State Fire Marshal.

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1. Installation and Fabrication drawings indicating the location of rigid and flexible couplings, seismic separation assemblies, planned clearance cut-outs between piping and solid structural members for seismic movement, and any additional anchoring points required for ceiling systems where sprinklers are fixed or supported in accordance with NFPA 13.
- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- G. Welding certificates.
- H. Field quality-control test reports.
- I. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction. The Engineer requires evidence to support the ability of the contractor to perform work in the scope and volume as specified. A contractor, who cannot show such experience, may be found not suitable to perform the work. The following are the approved contractors for this project:
 - a. PRE-APPROVED CONTRACTORS LIST
 - 1) A&D Fire
 - 2) Alta Fire
 - 3) Blazemaster Fire Protection
 - 4) Broken Arrow Fire Protection
 - 5) Certified Fire
 - 6) Delta Fire
 - 7) FireTrol
 - 8) FireFly Fire Protection
 - 9) Interwest Fire Protection
 - 10) Kimco Fire
 - 11) Quality Fire Protection
 - 12) Pye Barker Co.
 - 13) State Fire DC Specialties
 - 14) Summit Fire & Security
 - 15) The Safety Team (TST)
 - 16) Western Automatic Sprinkler Co.
 - 17) Or prior approved equal
 - b. A contractor not listed in the "PRE-APPROVED CONTRACTORS LIST" must receive prior approval from the engineer to bid this project.

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- B. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - 1. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer or NICET Level III technician.
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- D. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
- E. International Conference of Building Code Officials codes and standards complying with the following:
 - 1. IBC-2018, "International Building Code."
 - 2. IFC-2018, "International Fire Code."
- F. Utah Amendments
 - 1. Title 15A
- G. USU Design Standards.

1.8 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

1.10 General Engineering Quality

- A. Unless noted otherwise the following applies:
 - 1. The maximum water velocity shall not exceed 32-fps.
 - 2. Submit the calculations using the reduced flow data.

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3. When calculating flexible drops, the contractor shall use the maximum number of bends for the associated length. The value is to be taken from the UL tests (unless the material is only FM approved).
4. In the event of multiple (3) submittal rejections (including revise and resubmit) a meeting shall be held at the engineer's office at the engineer time of choosing and the designer, fire sprinkler contractor, and general contractor shall be physically in attendance to discuss the required modifications to the design.

1.11 Contract Completion

A. Incomplete and Unacceptable work:

1. If additional site visits or design work is required by the Engineer or Architect because of the use of incomplete or unacceptable work by the Contractor, then the Contractor shall reimburse the Engineer and Architect for all additional time and expenses involved.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, Class 53, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell end and plain end.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

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2.3 STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.
 - 1. Cast-Iron Threaded Flanges: ASME B16.1.
 - 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 - 3. Gray-Iron Threaded Fittings: ASME B16.4.
 - 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated. Include ends matching joining method.
 - 5. Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe where indicated.

- B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe not allowed.
 - 1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting not allowed.

- C. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe not allowed.
 - 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 - 2. Steel Flanges and Flanged Fittings: ASME B16.5.

- D. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, roll-grooved ends.
 - 1. Grooved-Joint Piping Systems:
 - a. Manufacturers:
 - 1) Anvil International, Inc.
 - 2) Bull Moose Tube Co.
 - 3) Grinnell (Tyco)
 - 4) Victaulic Co. of America.
 - 5) Wheatland Tube
 - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

- E. Threaded-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness Schedule 40, and with factory- or field-formed threaded ends.
 - 1. Cast-Iron Threaded Flanges: ASME B16.1.

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2. Malleable-Iron Threaded Fittings: ASME B16.3.
 3. Gray-Iron Threaded Fittings: ASME B16.4.
 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe.
 5. Steel Threaded Couplings: ASTM A 865.
- F. Plain-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10 not allowed.
1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting not allowed.
- G. Plain-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10 not allowed.
1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- H. Grooved-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10, and with factory- or field-formed, roll-grooved ends.
1. Grooved-Joint Piping Systems:
 - a. Manufacturers:
 - 1) Anvil International, Inc.
 - 2) Bull Moose Tube Co.
 - 3) Grinnell (Tyco)
 - 4) Victaulic Co. of America.
 - 5) Wheatland Tube
 - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.
- I. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 is not allowed.
- J. Plain-End, Nonstandard OD, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 10 is not allowed.
- K. Plain-End, Hybrid Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5 is not allowed.
- L. Grooved-End, Hybrid Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5; with factory- or field-formed, roll-grooved ends are not allowed.

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M. Schedule 5 Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with plain ends is not allowed.

2.4 CPVC TUBE AND FITTINGS

A. CPVC fire sprinkler pipe and fittings are not allowed.

2.5 FLEXIBLE SPRINKLER DROPS

A. Flexible connectors shall be exterior wire braid and have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:

1. NPS 1: Threaded.

B. Manufacturers:

1. Flex-Head
2. Victaulic

C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.6 FLEXIBLE PIPE CONNECTORS (SEISMIC)

A. Flexible connectors shall be exterior wire braid and have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:

1. NPS 2 and Smaller: Threaded.
2. NPS 2-1/2 and Larger: Flanged.
3. Option for NPS 2-1/2 and Larger: Grooved for use with grooved-end-pipe couplings.

B. Manufacturers:

1. Flexicraft Industries.
2. Flex-Pression, Ltd.
3. Metraflex, Inc.

C. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.

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- D. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- E. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.7 CORROSION-PROTECTIVE ENCASEMENT FOR PIPING

- A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

2.8 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be 175-psig minimum working-pressure rating and made of materials compatible with piping. Sprinkler specialty fittings shall have 250-psig minimum working-pressure rating if fittings are components of high-pressure piping systems.
- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body, with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
 - 1. Manufactures:
 - a. Central Sprinkler Corp.
 - b. Fire-End and Croker Corp.
 - c. Viking Corp.
 - d. Victaulic Co. of America.
- C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
- D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
- E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

2.9 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be 175-psig minimum pressure rating. Valves shall have 250-psig minimum pressure rating if valves are components of high-pressure piping system.
- B. Gate Valves with Wall Indicator Posts:
 - 1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.

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2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with hand wheel, extension rod, locking device, and cast-iron barrel.
 3. Manufacturers:
 - a. Grinnell Fire Protection.
 - b. McWane, Inc.; Kennedy Valve Div.
 - c. NIBCO.
 - d. Stockham.
- C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
 2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
 3. NPS 3: Ductile-iron body with grooved ends.
 4. Manufacturers:
 - a. NIBCO.
 - b. Victaulic Co. of America.
- D. Butterfly Valves: UL 1091.
1. NPS 2 and Smaller: Bronze body with threaded ends.
 - a. Manufacturers:
 - 1) Global Safety Products, Inc.
 - 2) Milwaukee Valve Company.
 2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
 - a. Manufacturers:
 - 1) Central Sprinkler Corp.
 - 2) McWane, Inc.; Kennedy Valve Div.
 - 3) Mueller Company.
 - 4) NIBCO.
 - 5) Victaulic Co. of America.
- E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
1. Manufacturers:
 - a. American Cast Iron Pipe Co.; Waterous Co.
 - b. Central Sprinkler Corp.
 - c. Clow Valve Co.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Fivalco Inc. dba Aleum USA
 - g. Globe Fire Sprinkler Corporation.

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- h. Grinnell Fire Protection.
- i. Hammond Valve.
- j. McWane, Inc.; Kennedy Valve Div.
- k. Mueller Company.
- l. NIBCO.
- m. Potter-Roemer; Fire Protection Div.
- n. Reliable Automatic Sprinkler Co., Inc.
- o. Star Sprinkler Inc.
- p. Stockham.
- q. United Brass Works, Inc.
- r. Victaulic Co. of America.
- s. Watts Industries, Inc.; Water Products Div.

F. Gate Valves: UL 262, OS&Y type.

- 1. NPS 2 and Smaller: Bronze body with threaded ends.

- a. Manufacturers:

- 1) Crane Co.; Crane Valve Group; Crane Valves.
 - 2) Fivalco Inc. dba Aleum USA.
 - 3) Hammond Valve.
 - 4) NIBCO.
 - 5) United Brass Works, Inc.

- 2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.

- a. Manufacturers:

- 1) Clow Valve Co.
 - 2) Crane Co.; Crane Valve Group; Crane Valves.
 - 3) Crane Co.; Crane Valve Group; Jenkins Valves.
 - 4) Fivalco Inc. dba Aleum USA
 - 5) Hammond Valve.
 - 6) Milwaukee Valve Company.
 - 7) Mueller Company.
 - 8) NIBCO.
 - 9) United Brass Works, Inc.

G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

- 1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch and Visual.
- 2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.

- a. Manufacturers:

- 1) Fivalco Inc. dba Aleum USA
 - 2) Milwaukee Valve Company.
 - 3) NIBCO.
 - 4) Victaulic Co. of America.

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3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

- a. Manufacturers:

- 1) Central Sprinkler Corp.
- 2) Fivalco Inc. dba Aleum USA
- 3) Grinnell Fire Protection.
- 4) McWane, Inc.; Kennedy Valve Div.
- 5) Milwaukee Valve Company.
- 6) NIBCO.
- 7) Victaulic Co. of America.

H. Supervised Normally Closed Valve

1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch and visual to send signal on partial close.

- a. Manufactures:

- 1) Fivalco Inc. dba Aleum USA
- 2) NIBCO.
- 3) Victaulic Co. of America.

2.10 UNLISTED GENERAL-DUTY VALVES

- A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
- B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
- D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.11 SPECIALTY VALVES

- A. Sprinkler System Control Valves: cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating. Control valves shall have 250-psig minimum pressure rating if valves are components of high-pressure piping system.

1. Manufacturers:

- a. Globe Fire Sprinkler Corporation.
- b. Reliable Automatic Sprinkler Co., Inc.
- c. Victaulic Co. of America.

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- d. Viking Corp.
- B. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.
 - 1. Manufacturers:
 - a. Grinnell Fire Protection.

2.12 SPRINKLERS

- A. Sprinklers shall be UL listed with 175-psig minimum pressure rating. Sprinklers shall have 250-psig minimum 300-psig pressure rating if sprinklers are components of high-pressure piping system.
- B. Sprinklers shall have 250-psig minimum 300-psig pressure rating if sprinklers are components of high-pressure piping system.
- C. Manufacturers:
 - 1. Globe Fire Sprinkler Corporation.
 - 2. Reliable Automatic Sprinkler Co., Inc.
 - 3. Victaulic Co. of America.
 - 4. Viking Corp.
 - 5. Tyco Fire
- D. Automatic Sprinklers: With heat-responsive element complying with the following:
 - 1. UL 199, for nonresidential applications.
 - 2. UL 1626, for residential applications.
- E. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
 - 1. Open Sprinklers: UL 199, without heat-responsive element.
 - a. Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.
 - b. Orifice: 17/32 inch, with discharge coefficient K between 7.4 and 8.2.
- F. Sprinkler types, features, and options as follows:
 - 1. Concealed ceiling sprinklers, including cover plate.
 - 2. Extended-coverage sprinklers, not allowed unless approved in writing prior to bidding.
 - 3. Flow-control sprinklers, with automatic open and shutoff feature.
 - 4. Flush ceiling sprinklers, including escutcheon, not allowed.
 - 5. Institution sprinklers, made with a small, breakaway projection.
 - 6. Pendent sprinklers.
 - 7. Pendent, dry-type sprinklers.
 - 8. Quick-response sprinklers.
 - 9. Sidewall sprinklers.
 - 10. Sidewall, dry-type sprinklers.

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11. Upright sprinklers.

- G. Sprinkler Finishes: Chrome plated, bronze, and painted.
- H. Special Coatings: Wax, lead, and corrosion-resistant paint.
- I. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Flat plate concealed, white.
 - 2. Sidewall Mounting: Flat plate concealed, white.
- J. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.13 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Electrically Operated Alarm: Horn/Strobe, NEMA 3R minimum suitable for outdoor use.
 - 1. Manufacturers:
 - a. Potter Electric Signal Company.
 - b. Safe Signal, formerly System Sensor.
- C. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 1. Manufacturers:
 - a. ADT Security Services, Inc.
 - b. Grinnell Fire Protection.
 - c. ITT McDonnell & Miller.
 - d. Potter Electric Signal Company.
 - e. Safe Signal, formerly System Sensor.
 - f. Viking Corp.
 - g. Watts Industries, Inc.; Water Products Div.
- D. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts, and design that operates on rising pressure and signals water flow.
 - 1. Manufacturers:

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- a. Grinnell Fire Protection.
 - b. Potter Electric Signal Company.
 - c. Safe Signal, formerly System Sensor.
 - d. Viking Corp.
- E. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
- 1. Manufacturers:
 - a. McWane, Inc.; Kennedy Valve Div.
 - b. Potter Electric Signal Company.
 - c. Safe Signal, formerly System Sensor.
- F. Indicator-Post Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.
- 1. Manufacturers:
 - a. Potter Electric Signal Company.
 - b. Safe Signal, formerly System Sensor.

2.14 PRESSURE GAGES

- A. Manufacturers:
- 1. Brecco Corporation.
 - 2. Dresser Equipment Group; Instrument Div.
 - 3. Marsh Bellofram.
 - 4. WIKA Instrument Corporation.
- B. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.
- 1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.
 - 2. Air System Piping: Include retard feature and caption "AIR" or "AIR/WATER" on dial face.

2.15 DOUBLE CHECK VALVE ASSEMBLIES

- A. Manufacturers
- 1. Ames
 - 2. Backflow Direct
 - 3. Febco
 - 4. Wilkins
 - 5. Watts

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- B. Description: Resilient seated, spring loaded with testable outlets provided, as required by Authorities Having Jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Obtain Engineer's Water Analysis or fire-hydrant flow test. Use results for system design calculations required in "Quality Assurance" Article in Part 1 of this Section.
- B. Engineer's Water Analysis. See Flow Analysis provided by Van Boerum & Frank Associates.

3.2 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.3 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PIPING APPLICATIONS

- A. Shop weld pipe joints where welded piping is indicated.
- B. Do not use welded joints for galvanized-steel pipe.
- C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- D. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- E. Underground Service-Entrance Piping: Ductile-iron, push-on or mechanical-joint pipe and fittings and restrained joints. Include corrosion-protective encasement.
- F. Sprinkler Main Piping: Use the following:

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1. NPS 6 and Smaller: Standard-weight steel pipe with threaded ends, or grooved ends. No plain ends allowed.
2. Outlets shall be welded.
 - a. Victaulic Brand Mechanical tee fittings may be used in lieu of welded outlets.

G. Branch line piping: Use the following:

1. NPS 1-1/4 and Smaller: Threadable steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.
 - a. Victaulic Brand Mechanical tee fittings may be used

H. Mains: Use the following:

1. NPS 4 to NPS 6: Schedule 40 steel pipe with grooved ends & Welded outlets.
2. NPS 3 and Smaller: Schedule 40 steel pipe with threaded ends, or grooved ends. No plain ends allowed.

3.5 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Fire-Protection-Service Valves: UL listed for applications where required by NFPA 13 and NFPA 14.
 2. General-Duty Valves: For applications where UL-listed valves are not required by NFPA 13 and NFPA 14.
 - a. Shutoff Duty: Use gate, ball, or butterfly valves.
 - b. Throttling Duty: Use globe, ball, or butterfly valves.

3.6 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Common Work Result for HVAC" for basic piping joint construction.
- B. Ductile-Iron-Piping, Grooved Joints: Use ductile-iron pipe with radius-cut-grooved ends; ductile-iron, grooved-end fittings; and ductile-iron, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
- C. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll-grooved ends and Schedule 30 or thinner steel pipe with roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.

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3.7 WATER-SUPPLY CONNECTION

- A. Install shutoff Backflow preventions assemblies, valve, pressure gages, drain, and other accessories at connection to water service.

3.8 PIPING INSTALLATION

- A. Refer to Division 23 Section "Common Work Result for HVAC" for basic piping installation.
- B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- F. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install alarm devices in piping systems.
- I. Hangers and Supports: Comply with NFPA 13 for hanger materials. Install according to NFPA 13 for sprinkler piping.
 - 1. No powder driven studs allowed.
 - 2. Wrap-around braces are to be provided at end of branch lines.
- J. Earthquake Protection: Install piping according to NFPA 13-9.3 requirements, to protect from earthquake damage. Seismic Bracing shall be designed to withstand vertical forces and movement.
- K. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated, or required by NFPA 13 for flexibility in seismic zones.
- L. Install pressure gages on riser or feed main, at each sprinkler test connection, Include pressure gages with connection not less than NPS 1/4 and with soft metal seated

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globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

- M. When a fire pipe crosses a seismic expansion joint it shall have a Metraflex fire loop installed at the joint in accordance with NFPA 13 chapter 9.

3.9 SPECIALTY SPRINKLER FITTING INSTALLATION

- A. Install specialty sprinkler fittings according to manufacturer's written instructions.

3.10 VALVE INSTALLATION

- A. Refer to Division 23 Section "Valves" for installing general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13 and NFPA 14, manufacturer's written instructions, and authorities having jurisdiction.
- B. Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.
- C. Double Check Valve Assemblies: Install valves in vertical up or horizontal position, per listings and for proper direction of flow.

3.11 SPRINKLER APPLICATIONS

- A. General: All sprinklers are to be quick response type. Sprinkler heads shall be of the latest design closed spray type for 155°F unless specified otherwise or required by code. Extended coverage heads shall not be used. Orifices larger than 1/2" may be used as required by density and spacing demands. Use sprinklers according to the following applications:
 - 1. Rooms without Ceilings: Upright and/or pendent sprinklers. Provide mechanical guards on all heads at or below 7'-0" height above the floor or where damage from room occupant use may occur.
 - 2. Rooms with Ceilings: Concealed sprinklers unless indicated otherwise.
 - 3. Wall Mounting: Concealed sidewall sprinklers unless indicated otherwise.
 - 4. Institutional sprinklers shall be installed in areas of detention, correctional or mental health care facilities.
 - 5. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.
 - 6. Provide freeze proof type automatic sprinkler heads serving unconditioned spaces, areas subject to freezing and in other areas requiring their use.
 - 7. Heads located within the air streams of unit heaters or other heat-emitting equipment shall be selected for proper temperature rating.
 - 8. Sprinkler Finishes: Use sprinklers with the following finishes:
 - a. Upright, Pendent, and Sidewall Sprinklers: Chrome in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

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- b. Concealed Sprinklers: Rough brass, with White cover plate to match ceiling color.
- c. Semi-Recessed Sprinklers: White, with white escutcheon.

B. Sprinklers: Use the following:

- 1. All sprinklers shall be listed, quick response type.
- 2. Sprinkler in future finish spaces (shelled) 10' x 10' spacing shall be pendants/uprights installed with 1 x ½" bushing, to accommodate future finishes.
- 3. Finish ceiling spaces shall have flat-plate concealed sprinklers.

3.12 SPRINKLER INSTALLATION

A. Every effort shall be required to ensure that the heads form a symmetrical pattern in the ceiling with the ceiling grid if included, as well as lights, diffusers, and grilles. Offsets shall be made in piping to accommodate ductwork in the ceiling. Heads shall be symmetrical in all ceilings and all piping run parallel or perpendicular to building lines. Heads shall be linearly aligned in corridors.

- 1. In no case shall sprinkler heads be installed closer than approved distances from ceiling obstructions and HVAC ductwork.
- 2. Sprinkler heads shall not conflict with tile grids.
- 3. Sprinkler heads shall be located near center of corridors.

B. Where layout of sprinkler heads is shown on reflected ceiling plans the locations shall be followed unless approval is obtained from the Architect, or such locations shown do not meet the requirements of NFPA-13. In either case, approval of the Architect shall be obtained in writing before sprinkler head locations are changed. If the installation of additional heads is needed to conform to NFPA 13 requirements in areas where heads are shown on reflected ceiling plans, they shall be included in the contract price.

C. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

D. Future finish shelled and tenant finish; Shell spaces shall be piped to accommodate future. Install sprinklers with 1" x ½" bushings, and space heads at a maximum spacing of 100 sq. ft. per head. Occupancy shall be Ordinary-Hazard Group 1 Design.

E. Concealed type sprinkler shall be installed in the following areas:

- 1. All areas.

3.13 CONNECTIONS

- A. Electrical Connections: Power wiring is specified in Division 28.
- B. Connect alarm devices to fire alarm.

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3.14 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14 and in Division 23 Section "Common Work Result for HVAC."

3.15 FIELD QUALITY CONTROL

- A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
- B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- C. When making a mechanical tee connection the coupon shall be attached at the mechanical tee.
- D. Report test results promptly and in writing to Architect and authorities having jurisdiction.
- E. Whether the underground serving the sprinkler system is done by this contractor or another, this contractor will be responsible to assure and have in his possession a certificate that the underground has been flushed and tested by the contractor who installed it in accordance with NFPA-24 prior to connection of the underground piping to the overhead sprinkler system.

3.16 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers having paint other than factory finish.

3.17 PROTECTION

- A. Protect sprinklers from damage until Substantial Completion.

3.18 COMMISSIONING

- A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
- B. Verify that specified tests of piping are complete, and that "Material Test Certificates" are complete.
- C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

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- D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
- E. Fill wet-pipe sprinkler piping with water.
- F. Coordinate with fire alarm tests. Operate as required.

3.19 DEMONSTRATION & TESTS

- A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.
- B. All tests will be conducted as required by the local authority having jurisdiction, and in no case less than those required by NFPA standards. As a minimum, piping in the sprinkler system shall be tested at a water pressure at 200 psi for a period of not less two hours, or at 50 psi more than the normal pressure when the normal pressure is above 150 psi. Bracing shall be in place, and air shall be removed from the system through the hydrants and drain valves before the test pressure is applied. No apparent leaks will be permitted on interior or underground piping.
- C. The local jurisdiction having authority and the Utah State Fire Marshal's office (where required) shall be notified at least three working days in advance of all tests and flushing. This includes any flushing of underground, hydrostatic testing, or flow testing that may be required.
- D. This contractor shall make all the required tests to the sprinkler system as required by code. He shall be responsible to assure that the Contractor Test Certificates for the overhead, backflow and underground work are completed and delivered to the owner's insurance underwriter to assure proper insurance credit.
- E. All tests requiring the witnessing by local authorities will be the responsibility of this contractor. If tests are not run or do not have the proper witness, then they will be run later and all damage caused by the system, or caused in uncovering the system for such test, will be borne by this contractor.

3.20 WARRANTY

- A. This contractor shall warranty the sprinkler system and all its components for one year from the date of acceptance by the owner. Any costs incurred to extend any warranties of materials to assure this time frame shall be borne by this contractor.
- B. Provide Operation and Maintenance Manuals with correct as-builts test certificates and warranties included. A minimum 6 sets to be provided in red 3-ring binders. Include a current adopted version of NFPA 25 softbound copy left with owner.
- C. Electronic copy of AutoCAD as-built drawings shall also be provided on CD, with each O&M Manual.

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3.21 FIELD QUALITY CONTROL

- A. Flush, test and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
- B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- C. Report test results promptly and in writing to Architect and authorities having jurisdiction.

END OF SECTION 21 1000

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Concrete bases.
 - 11. Supports and anchorages.
 - 12. Link Seal

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, and crawlspaces.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms, accessible pipe shafts, accessible plumbing chases and accessible tunnels.

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- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section **AND** USU's Published Design Standards, whichever is more stringent.

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1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

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1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

2.4 TRANSITION FITTINGS

- A. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
B. Insulating Material: Suitable for system fluid, pressure, and temperature.
C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.

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- e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
- 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
- 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

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2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- D. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

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2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.10 LINK SEAL

- A. Link-Seal® Modular Seal Pressure Plates
 - 1. Link-Seal® modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:
 - a. Izod Impact - Notched = 2.05ft-lb/in. per ASTM D-256
 - Flexural Strength @ Yield = 30,750 psi per ASTM D-790
 - Flexural Modulus = 1,124,000 psi per ASTM D-790
 - Elongation Break = 11.07% per ASTM D-638
 - Specific Gravity = 1.38 per ASTM D-792
 - 2. Models LS200-275-300-315 shall incorporate the most current Link-Seal® Modular Seal design modifications and shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which permits increased compressive loading of the rubber sealing element. Models 315-325-340-360-400-410-425-475-500-525-575-600 shall incorporate an integral recess known as a "Hex Nut Interlock" designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware. All pressure plates shall have a permanent identification of the manufacturer's name molded into it.
 - 3. For fire and Hi-Temp service, pressure plates shall be steel with 2-part Zinc Dichromate Coating.
 - 4. Link-Seal® Modular Seal Hardware: All fasteners shall be sized according to latest Link-Seal® modular seal technical data. Bolts, flange hex nuts shall be: 316 Stainless Steel per ASTM F593-95, with a 85,000 psi average tensile strength.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

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- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 SEISMIC REQUIREMENTS

- A. Comply with SEI/ASCE 7 and with requirements for seismic seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.

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- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
 - g. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

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- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

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- J. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.7 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

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1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.10 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.11 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.

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- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 220500

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SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 1.1 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

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- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Link-Seal
4. Metraflex Company (The).
5. Pipeline Seal and Insulator, Inc.
6. Proco Products, Inc.

- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: **EPDM-rubber** interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: **Carbon steel**
3. Connecting Bolts and Nuts: **Carbon steel, with corrosion-resistant coating**, of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: **5000-psi, 28-day** compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide **1-inch** annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches** above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in

penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than **NPS 6**: **Cast-iron wall sleeves.**
 - b. Piping **NPS 6** and Larger: **Cast-iron wall sleeves.**
 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than **NPS 6 (DN 150)**: **Cast-iron wall sleeves with sleeve-seal system**
 - 1) Select sleeve size to allow for **1-inch** annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping **NPS 6** and Larger: **Cast-iron wall sleeves with sleeve-seal system.**
 - 1) Select sleeve size to allow for **1-inch** annular clear space between piping and sleeve for installing sleeve-seal system.
 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than **NPS 6**: **Cast-iron wall sleeves with sleeve-seal system.**
 - 1) Select sleeve size to allow for **1-inch** annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping **NPS 6** and Larger: **Cast-iron wall sleeves with sleeve-seal system.**
 - 1) Select sleeve size to allow for **1-inch** annular clear space between piping and sleeve for installing sleeve-seal system.
 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than **NPS 6**: **Galvanized-steel-pipe sleeves.**
 - b. Piping **NPS 6** and Larger: **Galvanized-steel-pipe sleeves**
 5. Interior Partitions:
 - a. Piping Smaller Than **NPS 6**: **Galvanized-steel-pipe sleeves.**
 - b. Piping **NPS 6** and Larger: **Galvanized-steel-sheet sleeves.**

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

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- B. Install escutcheons with ID to 2 inch (50mm), tube, and insulation of insulated piping and with OD that completely covers opening.
1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type with polished, chrome-plated finish.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with chrome-plated finish.
 - d. Bare Piping 2 inch and Smaller at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping Larger than 2 inch at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type with polished, chrome-plated finish.
 - f. Bare Piping 2 inch and Smaller at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - g. Bare Piping Larger than 2 inch at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type with polished, chrome-plated finish.
 - h. Bare Piping 2 inch and Smaller in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
 - i. Bare Piping Larger than 2 inch in Unfinished Service Spaces: One-piece, stamped-steel type with polished, chrome-plated finish.
 - j. Bare Piping 2 inch and Smaller in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
 2. Escutcheons for Existing Piping:
 - a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with polished, chrome-plated finish and concealed hinge.
 - c. Bare Piping 2 inch and Smaller at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - d. Bare Piping Larger than 2 inch at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with polished, chrome-plated finish and concealed hinge.
 - e. Bare Piping 2 inch and Smaller at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - f. Bare Piping Larger than 2 inch at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with polished, chrome-plated finish and concealed hinge.
 - g. Bare Piping 2 inch and Smaller in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated or rough-brass finish.
 - h. Bare Piping Larger than 2 inch in Unfinished Service Spaces: Split-plate, stamped-steel type with polished, chrome-plated finish and concealed hinge.
 - i. Bare Piping 2 inch and Smaller in Equipment Rooms: Split-casting brass type with polished, chrome-plated or rough-brass finish.
 - j. Bare Piping Larger than 2 inch in Equipment Rooms: Split-plate, stamped-steel type with chrome- or cadmium-plated finish and concealed.

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3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

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SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze lift check valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Bronze globe valves.
8. Iron globe valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.

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- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.

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6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 2. Handwheel: For valves other than quarter-turn types.
 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 2. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Solder Joint: With sockets according to ASME B16.18.
 3. Threaded: With threads according to ASME B1.20.1.

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G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

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- B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.
- C. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. DynaQuip Controls.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Red-White Valve Corporation.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Three piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
- D. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.

2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Three piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. DeZurik Water Controls.
 - g. Flo Fab Inc.
 - h. Hammond Valve.
 - i. Kitz Corporation.
 - j. Milwaukee Valve Company.
 - k. NIBCO INC.
 - l. Norrisal; a Dover Corporation company.
 - m. Red-White Valve Corporation.
 - n. Spence Strainers International; a division of CIRCOR International, Inc.
 - o. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.

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- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.
- B. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. American Valve, Inc.
 - c. Conbraco Industries, Inc.; Apollo Valves.
 - d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - e. Crane Co.; Crane Valve Group; Center Line.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. DeZurik Water Controls.
 - h. Flo Fab Inc.
 - i. Hammond Valve.
 - j. Kitz Corporation.
 - k. Milwaukee Valve Company.
 - l. Mueller Steam Specialty; a division of SPX Corporation.
 - m. NIBCO INC.
 - n. Norriseal; a Dover Corporation company.
 - o. Spence Strainers International; a division of CIRCOR International, Inc.
 - p. Sure Flow Equipment Inc.
 - q. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nickel-plated or -coated ductile iron.
- C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. American Valve, Inc.
 - c. Conbraco Industries, Inc.; Apollo Valves.
 - d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. DeZurik Water Controls.
 - h. Flo Fab Inc.

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- i. Hammond Valve.
- j. Kitz Corporation.
- k. Milwaukee Valve Company.
- l. Mueller Steam Specialty; a division of SPX Corporation.
- m. NIBCO INC.
- n. Norrisal; a Dover Corporation company.
- o. Red-White Valve Corporation.
- p. Spence Strainers International; a division of CIRCOR International, Inc.
- q. Sure Flow Equipment Inc.
- r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Stainless steel.

2.5 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Design: Vertical flow.
- d. Body Material: ASTM B 61 or ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.6 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.

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- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Red-White Valve Corporation.
- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- l. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

B. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Red-White Valve Corporation.
- i. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 300 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.7 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Powell Valves.
- i. Red-White Valve Corporation.
- j. Sure Flow Equipment Inc.
- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- l. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

B. Class 250, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 500 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

2.8 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - j. Zy-Tech Global Industries, Inc.

2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

2.9 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Powell Valves.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.

2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

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- B. Class 250, Iron Globe Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.

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- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service Globe, angle, ball or butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or check valves.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.

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5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One, Two, or Three piece, full, regular or reduced port, with brass, bronze or stainless-steel trim.
3. Bronze Lift Check Valves: Class 125, bronze disc.
4. Bronze Swing Check Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze, ductile-iron or stainless-steel disc.
3. Iron Swing Check Valves: Class 125, metal seats.

3.6 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125 or Class 150, bronze disc.
3. Ball Valves: One, Two or Three piece, full or, regular port, bronze with bronze or stainless-steel trim.
4. Bronze Swing Check Valves: Class 125 or Class 150, bronze disc.
5. Bronze Globe Valves: Class 125 or Class 150, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Ball Valves: One, Two or Three piece, full or, regular port, bronze with bronze or stainless-steel trim.

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3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze, ductile-iron or stainless-steel disc.
4. Iron Swing Check Valves: Class 125 or Class 250, metal seats.
5. Iron Globe Valves: Class 125 or Class 250.

END OF SECTION 220523

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Pipe positioning systems.
 - 8. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
 - 3. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
 - 4. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 SEISMIC REQUIREMENTS

- A. Component Importance Factor. All plumbing components shall be assigned a component importance factor. The component importance factor, I_p , shall be taken as 1.5 if any of the following conditions apply:
 - 1. The component is required to function for life-safety purposes after an earthquake.
 - 2. The component contains hazardous materials.
 - 3. The component is in or attached to an Occupancy Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.
- B. All other components shall be assigned a component importance factor, I_p , equal to 1.0.

1.5 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
 - 1. For components with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. For components with a seismic importance factor of 1.5 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."

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1.6 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.
4. Pipe positioning systems.
5. Mechanical Anchors: ICC-ES Evaluation Reports validating 'Cracked Concrete' testing per A.C. 193 must be provided for anchors resisting seismic loads and/or supporting life- safety systems including fire sprinkler systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

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. Seismic calculations and detailed analysis: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices. Project specific design documentation and calculations shall be prepared and stamped by a registered professional engineer who is responsible for the seismic restraint design and who is licensed in the state where the project is being constructed (ASCE 7, 13.2.1.1).

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1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel.", AWS D1.4, "Structural Welding Code--Reinforcing Steel." and ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 4. ASME Boiler and Pressure Vessel Code: Section IX.

1.8 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. Anvil International.
 - 2. AAA Technology & Specialties Co., Inc.
 - 3. Bergen-Power Pipe Supports.
 - 4. B-Line Systems, Inc.; a division of Cooper Industries.

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5. Carpenter & Paterson, Inc.
6. Empire Industries, Inc.
7. ERICO/Michigan Hanger Co.
8. FNW/Ferguson Enterprises
9. Globe Pipe Hanger Products, Inc.
10. Grinnell Corp.
11. GS Metals Corp.
12. National Pipe Hanger Corporation.
13. PHD Manufacturing, Inc.
14. PHS Industries, Inc.
15. Piping Technology & Products, Inc.
16. Tolco Inc.
17. Simpson Strong-Tie Co.

- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 1. Anvil International.
 2. B-Line Systems, Inc.; a division of Cooper Industries.

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3. ERICO/Michigan Hanger Co.; ERISTRUT Div.
4. FNW/Ferguson Enterprises
5. GS Metals Corp.
6. Hilti, Inc.
7. Power-Strut Div.; Tyco International, Ltd.
8. Thomas & Betts Corporation.
9. Tolco Inc.
10. Unistrut Corp.; Tyco International, Ltd.

- C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
1. Carpenter & Paterson, Inc.
 2. ERICO/Michigan Hanger Co.
 3. PHS Industries, Inc.
 4. Pipe Shields, Inc.
 5. Rilco Manufacturing Company, Inc.
 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

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- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- 1. Manufacturers:

- a. Hilti, Inc.
- b. MKT Fastening, LLC.
- c. Powers Fasteners.
- d. Simpson Strong-Tie Co.

- B. Mechanical-Expansion Anchors and Concrete Screws: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. For anchors resisting seismic loads and/or supporting life- safety systems including fire sprinkler systems, Anchors shall have been tested for 'Cracked Concrete' per A.C. 193 per a valid ICC-ES Evaluation Report. Manufacturers with these anchors have been designated below with: '*'

- 1. Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
- b. Empire Industries, Inc.
- c. Hilti, Inc.
- d. ITW Ramset/Red Head.
- e. MKT Fastening, LLC.
- f. Powers Fasteners.
- g. Simpson Strong-Tie Co. *

2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

- 1. Manufacturers:

- a. Anvil International.
- b. ERICO/Michigan Hanger Co.
- c. MIRO Industries.
- d. Unipure

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- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. MIRO Industries.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. Anvil International.
 - b. ERICO/Michigan Hanger Co.
 - c. MIRO Industries.
 - d. Portable Pipe Hangers.
 - 2. Base: Stainless steel.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. Anvil International.
 - b. Portable Pipe Hangers.
 - 2. Bases: One or more plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.8 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

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B. Manufacturers:

1. C & S Mfg. Corp.
2. HOLDRITE Corp.; Hubbard Enterprises.
3. Samco Stamping, Inc.

2.9 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.10 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

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1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.

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17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18 or Simpson Blue Banger Concrete insert with UL & FM approvals): For upper attachment to suspend pipe hangers from concrete ceiling.

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2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

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3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- C. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Powder actuated fasteners shall not be used for seismic bracing attachments.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. For anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems, anchors shall have been tested for 'Cracked Concrete' per A.C. 193 and shall have a valid ICC-ES Evaluation Report
- G. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

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- H. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- P. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

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4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
5. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
6. Pipes NPS 8 and Larger: Include wood inserts.
7. Insert Material: Length at least as long as protective shield.
8. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports. For applications where seismic bracing is required, 'Cracked Concrete' expansion anchors or concrete screws tested per A.C. 193 must be provided for seismic bracing anchorage where post-installed anchors are required.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

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3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches .

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

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SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following restraints and vibration isolation as defined in Section 230548 "Vibration Isolation and Seismic Controls for HVAC" for the following:
 - 1. Plumbing Piping.
 - 2. Plumbing Equipment.

1.3 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 (NOT USED)

PART 3 - EXECUTION

3.1 (NOT USED)

END OF SECTION 220548

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SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

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- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.5 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
 2. Letter Color: White.
 3. Background Color: Blue.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
 - C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus

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the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. Manufacturers:
 - 1. W.H. Brady Co., 727 West Glendale Ave., Milwaukee, Wisconsin
 - 2. Seton Name Plate Corp., 592 Boulevard, New Haven Connecticut.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

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1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: 2" high for pipe sizes NPS 3" or larger. 1" high for pipe sizes NPS 2 1/2" and under.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 1. Stencil Material: Fiberboard or metal.
 2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 1. Size: 3 by 5-1/4 inches minimum.
 2. Fasteners: Brass grommet and wire.

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3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
 1. Identification Paint: Use for contrasting background.
 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.

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6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Domestic Water Piping:
 - a. Background Color: Comply with ASME A13.1.
 - b. Letter Color: Comply with ASME A13.1.
2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Comply with ASME A13.1.
 - b. Letter Color: Comply with ASME A13.1.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches, round.
 - b. Hot Water: 1-1/2 inches, round.
 2. Valve-Tag Color:
 - a. Cold Water: Comply with ASME A13.1.
 - b. Hot Water: Comply with ASME A13.1.
 3. Letter Color:
 - a. Cold Water: Comply with ASME A13.1.
 - b. Hot Water: Comply with ASME A13.1.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

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SECTION 220700 - PLUMBING INSULATION

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. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
- 2. Adhesives.
- 3. Lagging adhesives.
- 4. Sealants.
- 5. Factory-applied jackets.
- 6. Field-applied fabric-reinforcing mesh.
- 7. Field-applied jackets.
- 8. Tapes.
- 9. Securements.
- 10. Corner angles.

- B. Related Sections include the following:

- 1. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:

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1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail attachment and covering of heat tracing inside insulation.
 3. Detail insulation application at pipe expansion joints for each type of insulation.
 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 6. Detail application of field-applied jackets.
- C. Qualification Data: For qualified Installer.
- D. 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.
- E. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

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1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

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1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.

- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglass 700 Series.

- I. Mineral-Fiber, Preformed Pipe Insulation:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000(Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fibreglas Pipe Insulation.

 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

- J. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100

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deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; AeroSeal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.

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- b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
- c. P.I.C. Plastics, Inc.; Welding Adhesive.
- d. Red Devil, Inc.; Celulon Ultra Clear.
- e. Speedline Corporation; Speedline Vinyl Adhesive.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Encacel.
 - b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
 - c. Marathon Industries, Inc.; 570.
 - d. Mon-Eco Industries, Inc.; 55-70.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 5. Color: White.

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2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.
 - d. Mon-Eco Industries, Inc.; 11-30.
 - e. Vimasco Corporation; 136.
 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
 3. Service Temperature Range: Minus 50 to plus 180 deg F.
 4. Color: White.

2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
- B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.

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5. Color: White.

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
5. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:

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- a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 5. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

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1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.

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3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.9 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.

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- c. RPR Products, Inc.; Bands.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Aluminum or Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

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- d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Aluminum or Stainless steel], fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum or stainless-steel] sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, stainless steel.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.

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- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

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- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.

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4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 1. Comply with requirements in Division 07 Section "Penetration Firestopping" and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.

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6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum or stainless steel, at least 0.040 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be

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- butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

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1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

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D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

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2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

D. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.

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2. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.10 FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.
- E. Insulation shall have a k value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

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- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1-1/2 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch
 - 2. NPS 2 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/2 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch.
 - 2. NPS 2 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
- C. Stormwater and Overflow:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch.
- D. Roof Drain and Overflow Drain Bodies:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Storm Water and Overflow Piping Where Heat Tracing Is Installed:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

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3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
 - 1. None.
- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches.
 - 1. Aluminum, Stucco Embossed: 0.016 inch thick.
- E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
 - 1. Aluminum, Stucco Embossed with 1-1/4-Inch- Deep Corrugations: 0.032 inch thick.
- F. Piping, Concealed:
 - 1. None.
- G. Piping, Exposed:
 - 1. PVC: 20 mils thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. None.
- D. Piping, Exposed:
 - 1. PVC: 20 mils thick.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

B. Related Requirements:

1. Division 22 Section "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

B. 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.

1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

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1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Construction Manager or owner no fewer than two days in advance of proposed interruption of water service.

1.6 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."
- C. All piping shall be American made and tested; no import pipe will be permitted.
- D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.
- E. All piping installed in or passing through a plenum must be plenum rated, fire wrapped, or installed in a metal conduit.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: **ASTM B 88, Type L** water tube, drawn temper.
- B. Soft Copper Tube: **ASTM B 88, Type L** water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:

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1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. PP Pipe and Fittings: Manufacturer's recommended fusion-weld system.

2.4 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Piping Specialties Products.
 - c. Ford Meter Box Company, Inc. (The).

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- d. JCM Industries.
- e. Romac Industries, Inc.
- f. Smith-Blair, Inc.; a Sensus company.
- g. Viking Johnson.

D. Plastic-to-Metal Transition Fittings:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
- 2. Description:
 - a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. PP-to-Metal Transition Fittings:

- 1. Description:
 - a. PP one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one fusion-socket end.

F. Plastic-to-Metal Transition Unions:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Colonial Engineering, Inc.
 - b. NIBCO Inc.
 - c. Spears Manufacturing Company.
- 2. Description:
 - a. **CPVC** four-part union.
 - b. **Brass** threaded end.
 - c. **Solvent-cement-joint** plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

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B. Dielectric Nipples and Waterways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Matco-Norca.
 - d. Clearflow/Perfection Corp.
 - e. Precision Plumbing Products, Inc.
 - f. Victaulic Company.
2. Standard: IAPMO PS 66 or ASTM F-1545-97.
3. Electroplated steel nipple or waterway complying with ASTM F 1545 or ANSI/NSF-61 Compliant.
4. Pressure Rating and Temperature: **300 psig at 225 deg F.**
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene or LTHS.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Polypropylene pipe in or passing through plenums must be fire wrapped or installed in a metal conduit.
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Division 22 Section "Domestic Water Piping Specialties."
- D. Install shutoff valve immediately upstream of each dielectric fitting.

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- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Division 22 Section "Domestic Water Piping Specialties."
- F. Install domestic water piping level **with 0.25 percent slope downward toward drain** and plumb.
- G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- H. Install seismic restraints on piping. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping to permit valve servicing.
- M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and branch connections.
- P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Division 22 Section "Domestic Water Pumps."
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

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3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- G. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- H. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- I. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- J. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:

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1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition **fittings**.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use **dielectric nipples/waterways**.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use **dielectric nipples/waterways**.
- D. Dielectric Fittings for NPS 5 and Larger: Use **dielectric nipples/waterways**

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
 1. Vertical Piping: MSS Type 8 or 42, clamps.
 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.

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3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 6. NPS 6: 10 feet with 5/8-inch rod.
 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 3. NPS 2: 10 feet with 3/8-inch rod.
 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 7. NPS 6: 12 feet with 3/4-inch rod.
 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Install supports for vertical PP piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.
- J. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

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1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code. Comply with requirements for connection sizes in Division 22 plumbing fixture Sections.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Division 22 Section "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

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- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

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2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

- A. Some piping types and sizes mentioned in this section may not be used on this project.
- B. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- C. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.
- E. Aboveground domestic water piping shall be one of the following:

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1. Hard copper tube, **ASTM B 88, Type L cast** copper, solder-joint fittings; and **soldered** joints.

3.13 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use **ball valves** for piping NPS 3 and smaller. Use **butterfly valves** with flanged ends for piping NPS 4 and larger.
 2. Throttling Duty: Use **ball** valves for piping NPS 2 and smaller. Use **butterfly** valves with flanged ends for piping NPS 2-1/2 and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: **Calibrated** balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

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SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose bibbs.
9. Wall hydrants.
10. Drain valves.
11. Water hammer arresters.
12. Trap-seal primer valves.
13. Trap-seal primer systems.

- B. Related Sections include the following:

1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.

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- 3. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

1.6 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1001.
 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: Threaded.
 6. Finish: Chrome plated.
- B. Hose-Connection Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. MIFAB, Inc.
 - e. Prier Products, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1011.
 3. Body: Bronze, nonremovable, with manual drain.
 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 5. Finish: Chrome or nickel plated.
- C. Pressure Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.

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- c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Toro Company (The); Irrigation Div.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1020.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

D. Spill-Resistant Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.

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5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved] for NPS 2-1/2 and larger.
 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 7. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- B. Double-Check Backflow-Prevention Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1015.
 3. Operation: Continuous-pressure applications, unless otherwise indicated.
 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 6. End Connections: Threaded for NPS 2 and smaller; [flanged] <Insert type> for NPS 2-1/2 and larger.
 7. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
- C. Beverage-Dispensing-Equipment Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Plumbing Products Group; Wilkins Div.

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2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

D. Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Ford Meter Box Company, Inc. (The).
 - f. Honeywell Water Controls.
 - g. McDonald, A. Y. Mfg. Co.
 - h. Mueller Co.; Water Products Div.
 - i. Watts Industries, Inc.; Water Products Div.
 - j. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Body: Bronze with union inlet.

E. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Lancer Corporation.
 - c. Watts Industries, Inc.; Water Products Div.
2. Standard: ASSE 1032.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

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2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators: (Direct Type)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. Honeywell Water Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze, provide chrome-plated finish if connected to chrome plated or stainless steel piping for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water Control Valves: (Pilot type)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CLA-VAL Automatic Control Valves.
 - b. Mifab Corp; Beeco.
 - c. Watts Industries, Inc.; Ames Fluid Control Systems.
 - d. Watts Industries, Inc.; Watts ACV.
 - e. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

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2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. NIBCO INC. Model S/T/PC-1810-LF
 - e. TAC Americas.
 - f. Taco, Inc.
 - g. Victaulic
 - h. Watts Industries, Inc.; Water Products Div.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: bronze,
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. NIBCO INC. (F-737 or F-739)
 - e. TAC Americas.
 - f. Watts Industries, Inc.; Water Products Div.
2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. Armstrong International, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Honeywell Water Controls.
 - e. Leonard Valve Company.
 - f. Powers; a Watts Industries Co.
 - g. Symmons Industries, Inc.
 - h. Taco, Inc.
 - i. Watts Industries, Inc.; Water Products Div.
 - j. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1017.
 3. Pressure Rating: 125 psig.
 4. Type: Thermostatically controlled water mixing valve.
 5. Material: Bronze body with corrosion-resistant interior components.
 6. Connections: Threaded union inlets and outlet.
 7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 8. Valve Finish: Rough bronze.
- B. Primary, Thermostatic, Water Mixing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a Watts Industries Co.
 - e. Symmons Industries, Inc.
 2. Standard: ASSE 1017.
 3. Pressure Rating: 125 psig.
 4. Type: Exposed-mounting, thermostatically controlled water mixing valve.
 5. Material: Bronze body with corrosion-resistant interior components.
 6. Connections: Threaded union inlets and outlet.
 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.

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9. Valve Finish: Chrome plated.
10. Piping Finish: Copper.

C. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. Honeywell Water Controls.
 - d. Lawler Manufacturing Company, Inc.
 - e. Leonard Valve Company.
 - f. Powers; a Watts Industries Co.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 - c. Strainers NPS 5 and Larger: 0.10 inch.

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6. Drain: Factory-installed, hose-end drain valve.

2.7 OUTLET BOXES

A. Icemaker Outlet Boxes ICE-1:

1. Basis of Design: Guy Gray model FR1212SHACP fire rated washing machine box with one ¼ turn valve with water hammer arrestor and 1-1/2" drain connection.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Guy Gray Manufacturing Co., Inc.
 - c. IPS Corporation.
 - d. LSP Products Group, Inc.
 - e. Oatey.
 - f. Plastic Oddities; a division of Diverse Corporate Technologies.
 - g. Symmons Industries, Inc.
 - h. Watts Industries, Inc.; Water Products Div.
 - i. Whitehall Manufacturing; a div. of Acorn Engineering Company.
 - j. Zurn Plumbing Products Group; Light Commercial Operation.
3. Mounting: Recessed.
4. Material and Finish: Enameled-steel or epoxy-painted-steel or plastic box and faceplate.
5. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
6. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
7. Drain: NPS 1-1/2 standpipe and P-trap for direct waste connection to drainage piping.
8. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
9. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.

B. Water Outlet Boxes W-1:

1. Basis of Design: Water-Tite model W9200HA 6" diameter outlet box with ¼ turn valve and water hammer arrestor.

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2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. IPS Corporation.
 - c. LSP Products Group, Inc.
 - d. Oatey.
 - e. Plastic Oddities; a division of Diverse Corporate Technologies.
3. Mounting: Recessed.
4. Material and Finish: Enameled-steel or epoxy-painted-steel or plastic box and faceplate.
5. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
6. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.8 HOSE BIBBS

A. Hose Bibbs HB-1:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.

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14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

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2.11 TRAP-SEAL PRIMER VALVES

- A. TP-1 Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:
 - 1. 125-psig minimum working pressure.
 - 2. Bronze body with atmospheric-vented drain chamber.
 - 3. Inlet and Outlet Connections: 1/2-inch threaded, union, or solder joint.
 - 4. Gravity Drain Outlet Connection: 1/2-inch threaded or solder joint.
 - 5. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

- B. TP-2 Trap Seal Primer Valves: Electric water-supply-fed trap priming manifold with the following characteristics:
 - 1. 125-psig minimum working pressure.
 - 2. Bronze body with atmospheric-vented drain chamber.
 - 3. Inlet and Outlet Connections: 3/4-inch inlet and 1/2-inch outlet threaded, union, or solder joint.
 - 4. Gravity Drain Outlet Connection: 1/2-inch threaded or solder joint.
 - 5. Electric solenoid valve 120 volt.
 - 6. Water hammer arrestor.
 - 7. Vacuum breaker.
 - 8. Factory fabricated. 4 outlets to 30 outlets as shown on drawings.

- C. Trap-Seal Primer Systems TP-3:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. PPP Inc.
 - 2. Standard: ASSE 1044,
 - 3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
 - 4. Cabinet: Surface-mounting steel box with stainless-steel cover.
 - 5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.

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6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: As indicated on drawings.
8. Size Outlets: NPS 1/2.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- C. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install thermometers and water regulators if specified.
 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- G. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- H. Install water hammer arresters in water piping according to PDI-WH 201.

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- I. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- J. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- K. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Reduced-pressure-principle backflow preventers.
 - 3. Double-check backflow-prevention assemblies.
 - 4. Carbonated-beverage-machine backflow preventers.
 - 5. Dual-check-valve backflow preventers.
 - 6. Water pressure-reducing valves.
 - 7. Calibrated balancing valves.
 - 8. Primary, thermostatic, water mixing valves.
 - 9. Primary water tempering valves.
 - 10. Outlet boxes.
 - 11. Supply-type, trap-seal primer valves.

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12. Trap-seal primer systems.

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

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SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

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1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-sewer" for plastic sewer piping; "NSF-drain" for plastic drain piping, and "NSF-tubular" for plastic continuous waste piping.

1.7 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify **Construction Manager** and **Owner** no fewer than **two** days in advance of proposed interruption of sanitary waste service.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: All cast-iron waste, vent and sewer pipe and fittings shall conform to the requirements of CISPI Standard 301 and ASTM A 888. All products shall be marked with the collective trademark of the Cast Soil Pipe Institute and shall be listed by NSF International or receive prior approval of the engineer. All cast-iron pipe and fittings shall be American made and tested. Non-compliant import cast-iron products will not be permitted. Any non-compliant cast-iron product installed by the contractor on this project will be replaced at the contractor's expense and shall include all repairs, patching, painting and other incidental work required to return the project to its pre-remediation state.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AB&I Foundry

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- b. Charollte Pipe
- c. Tyler Pipe

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO.
 - b. Ideal
 - c. Mission Rubber Company; a division of MCP Industries, Inc.
 - d. Tyler Pipe.
2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
4. Listing: Couplings shall be listed by NSF International. Each coupling shall be embossed with the NSF seal.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Husky SD 4000.
 - b. Clamp-All Corp HI-TORQ 125.
2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

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- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.

- J. Install seismic restraints on piping. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

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1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- O. Install underground **PVC** piping according to ASTM D 2321.
- P. Install engineered soil and waste drainage and vent piping systems as follows:
 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- Q. Plumbing Specialties:
 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Sanitary Waste Piping Specialties."
 2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
 3. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Plastic, No pressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

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3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install **carbon-steel** pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install **stainless-steel** pipe hangers for horizontal piping in corrosive environments.
 - 3. Install **carbon-steel** pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each **fitting and coupling or valve and coupling**.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.

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5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Comply with requirements for **cleanouts and drains** specified in Division 22 Section "Sanitary Waste Piping Specialties."
 6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make fixture and equipment connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

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3.6 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than **10-foot head of water**. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of **1-inch wg**. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

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5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping **NPS 3** and smaller shall be the following:
 1. Hubless, cast-iron soil pipe and fittings **CISPI** hubless-piping couplings; and coupled joints.
- C. Aboveground, soil and waste piping **NPS 4** and larger shall be the following:
 1. Hubless, cast-iron soil pipe and fittings **heavy-duty** hubless-piping couplings; and coupled joints.
- D. Aboveground, vent piping **NPS 3** and smaller shall be the following:
 1. Hubless, cast-iron soil pipe and fittings **CISPI** hubless-piping couplings; and coupled joints.
- E. Aboveground, vent piping **NPS 4** and larger shall be the following:
 1. Hubless, cast-iron soil pipe and fittings **CISPI** hubless-piping couplings; and coupled joints.

END OF SECTION 221316

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SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Channel drainage systems.
 - 4. Roof flashing assemblies.
 - 5. Through-penetration firestop assemblies.
 - 6. Miscellaneous sanitary drainage piping specialties.
 - 7. Flashing materials.
 - 8. Grease removal devices.
- B. Related Sections include the following:
 - 1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 SEISMIC REQUIREMENTS

- A. Component Importance Factor. All plumbing components shall be assigned a component importance factor. The component importance factor, I_p , shall be taken as 1.5 if any of the following conditions apply:
 - 1. The component is required to function for life-safety purposes after an earthquake.
 - 2. The component contains hazardous materials.

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3. The component is in or attached to an Occupancy Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.
- B. All other components shall be assigned a component importance factor, I_p , equal to 1.0.
- C. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

1.4 DEFINITIONS

- A. FOG: Fats, oils, and greases.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
 1. FOG disposal systems.
 2. Grease removal devices.
- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that FOG disposal systems, grease interceptors, grease removal devices, oil interceptors, accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

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- a. For components with a seismic importance factor of 1.0 the term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. For components with a seismic importance factor of 1.5 the term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control test reports.
 - E. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.7 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

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PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. Sun Drainage Products
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
 - h. Sun Drainage Products
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.

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6. Clamping Device: Required.
7. Outlet Connection: Inside call.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. Sun Drainage Products

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.

5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

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7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: See Schedule at end of this Section:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. Sun Drainage Products
3. Standard: ASME A112.6.3.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Not required.
7. Outlet: Bottom.
8. Trap Material: Cast iron>.
9. Trap Pattern: Deep-seal P-trap>.
10. Trap Features: Trap-seal primer valve drain connection>.

2.3 CHANNEL DRAINAGE SYSTEMS

A. Plastic Channel Drainage Systems ID-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Zurn Plumbing Products Group; Flo-Thru Operation.
 - d. NDS Inc.

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- e. Dura Trench; Division of Ericsons
- 2. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Channel Sections: Interlocking-joint, SMC/GRP, HDPE or PE modular units, with end caps. Include flat, rounded, or inclined bottom, with level invert and with outlets in number, sizes, and locations indicated. Provide drain lengths indicated on drawings.
 - 1) Dimensions: 4 inches wide. Include number of units required to form total lengths indicated.
 - b. Grates: With slots or perforations and widths and thickness that fit recesses in channel sections.
 - 1) Material: Gray iron.
 - c. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - d. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
- 3. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
- 4. Size: Same as connected soil, waste, or vent stack.
- 5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
- 6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
- 7. Special Coating: Corrosion resistant on interior of fittings.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

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1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- B. Floor-Drain, Trap-Seal Primer Fittings:
1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- C. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 2. Body: Bronze or cast iron.
 3. Inlet: Opening in top of body.
 4. Outlet: Larger than inlet.
 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- D. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch > above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 2. Size: As required for close fit to riser or stack piping.
- E. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 2. Size: Same as connected stack vent or vent stack.
- F. Vent Cap Filters:
1. Description: Activated carbon filter in housing for installation at vent terminal as manufactured by Sweet Filter.

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2. Size: Same as connected stack vent or vent stack.

2.6 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.
- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.7 GREASE REMOVAL DEVICES

- A. Grease Removal Devices:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide ECH2O grease removal system as manufactured by API Industries or a comparable product by one of the following:
 - a. Applied Chemical Technology, Incorporated.
 - b. Grease Removal Systems.
 - c. G K & L, Inc.
 - d. International Grease Recovery Device.
 - e. Josam Company; Blucher-Josam Div.
 - f. Lowe Engineering; a division of Highland Tank & Manufacturing Co., Inc.
 - g. Thermaco, Inc.
 - h. Town and Country
 3. Provide system complete with in-line fixture filters, sump and lift station, and grease/oil removal unit.

PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Anchor grease removal devices to concrete bases.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.
 - 2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
 - 6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.2 INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- C. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- D. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.

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- E. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- F. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- G. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- H. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- I. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- M. Install vent cap filters on each vent pipe passing through roof.
- N. Install grease removal devices on floor as required by the manufacturer complete with all controls and power wiring.

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- O. Install wood-blocking reinforcement for wall-mounting-type specialties.
- P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- Q. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Removal Devices: Connect controls, electrical power, factory-furnished accessories, and inlet, outlet, and vent piping to unit.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.

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- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.5 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Grease removal devices.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled grease removal devices and their installation, including piping and electrical connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.7 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain grease removal devices. Refer to Division 01 Section "Demonstration and Training."

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3.9 FLOOR DRAIN SCHEDULE

FD-1 Floor Drain: Smith figure 2010-BP cast iron body and flashing collar with square nickel bronze adjustable strainer head with secured square hole grate and trap primer connection.

FS-1 Floor Sink: Smith figure 3100 cast iron flanged receptor with acid resistant interior coating, nickel bronze rim and secured grate and aluminum dome bottom strainer. Coordinate grate configuration with Kitchen Equipment drawings.

END OF SECTION 221319

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SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories bathtub/showers showers and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Water closets.
7. Urinals.
8. Lavatories.
9. Commercial sinks.
10. Kitchen sinks.
11. Service sinks.
12. Owner-furnished fixtures.

- B. Related Sections include the following:

1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
3. Division 22 Section "Emergency Plumbing Fixtures."

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4. Division 22 Section "Drinking Fountains and Water Coolers."

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- C. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- D. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- E. FRP: Fiberglass-reinforced plastic.
- F. PMMA: Polymethyl methacrylate (acrylic) plastic.
- G. PVC: Polyvinyl chloride plastic.
- H. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

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- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 3. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 4. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 5. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 6. Vitreous-China Fixtures: ASME A112.19.2M.
 - 7. Water-Closet, Flushometer Tank Trim: ASSE 1037.
 - 8. Whirlpool Bathtub Fittings: ASME A112.19.8M.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 6. Hose-Coupling Threads: ASME B1.20.7.

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7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 8. NSF Potable-Water Materials: NSF 61.
 9. Pipe Threads: ASME B1.20.1.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Supply Fittings: ASME A112.18.1.
 12. Brass Waste Fittings: ASME A112.18.2.
 13. NSF61 Appendage G-AB 1953. Lead free potable drinking faucets.
- I. Comply with the following applicable standards and other requirements specified for bathtub/shower and shower faucets:
1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
 4. Faucets: ASME A112.18.1.
 5. Hand-Held Showers: ASSE 1014.
 6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 7. Hose-Coupling Threads: ASME B1.20.7.
 8. Manual-Control Antiscald Faucets: ASTM F 444.
 9. Pipe Threads: ASME B1.20.1.
 10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 12. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Dishwasher Air-Gap Fittings: ASSE 1021.

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4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
8. NSF61 Appendage G-AB 1953. Lead free potable drinking faucets.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Dishwasher Air-Gap Fittings: ASSE 1021.
3. Flexible Water Connectors: ASME A112.18.6.
4. Floor Drains: ASME A112.6.3.
5. Grab Bars: ASTM F 446.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Off-Floor Fixture Supports: ASME A112.6.1M.
8. Pipe Threads: ASME B1.20.1.
9. Plastic Toilet Seats: ANSI Z124.5.
10. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 OWNER SPECIFICATION COMPLIANCE

A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

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3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Toilet Seats: Equal to 5 percent of amount of each type installed.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Moen
 - b. Symmons
 - c. Zurn
 - d. Sloan
2. Description: Battery operated sensor type. Commercial freehand type faucet with thermostatic mixing valve, single hole, AA batteries, components above counter, and thermal or proximity sensor.

2.2 SINK FAUCETS

A. Sink Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago Faucets.
 - b. T & S Brass and Bronze Works, Inc.
 - c. Moen, Inc.

2.3 FLUSHOMETERS

A. Flushometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sloan Valve Company.
 - b. Zurn Plumbing Products Group; Commercial Brass Operation.
 - c. Moen, Inc.
 - d. AMTC

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2.4 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bemis Manufacturing Company.
 - b. Centoco Manufacturing Corp.
 - c. Church Seats.
 - d. Olsonite Corp.
 - e. Sperzel.
2. Description: Toilet seat for water-closet-type fixture.
 - a. Material: Molded, solid plastic with antimicrobial agent.
 - b. Configuration: Open front without cover.
 - c. Size: Elongated.
 - d. Hinge Type: CK, check.
 - e. Class: Heavy-duty commercial.
 - f. Color: White.

2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements. Product shall also meet the ASTM E 84 25/450 smoke and flame rating.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. TRUEBRO, Inc.

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2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.6 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.
7. Sun Drainage Products

- B. Urinal Supports:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

- C. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.7 WATER CLOSETS

- A. Water Closets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Kohler Co.
 - c. Sloan

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2.8 URINALS

A. Urinals:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Briggs Plumbing Products, Inc.
 - c. Kohler Co.
 - d. Sloan

2.9 LAVATORIES

A. Lavatories:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Briggs Plumbing Products, Inc.
 - c. Kohler Co.
 - d. Sloan

2.10 COMMERCIAL SINKS

A. Commercial Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Company.

2.11 SERVICE SINKS

A. Service Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Commercial Enameling Company.
 - c. Kohler Co.

2.12 KITCHEN EQUIPMENT

A. Kitchen Equipment (as noted on Kitchen Equipment Schedule):

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1. Rough-in and connect to Kitchen equipment as per the Kitchen Equipment Rough-in drawings. Provide all "P" traps required, chrome-plated cast brass. Tail pieces and trap arms shall be chrome-plated 17 ga. brass tubing.
2. Provide Precision Plumbing Products water hammer arrestors upstream of all quick-closing valves, such as on disposers and dishwasher.
3. Gas and water services to portable and countertop appliances shall be connected to equipment with flexible tubing and quick-disconnect fittings. Gas fittings and hoses shall be A.G.A. approved for commercial kitchen equipment.
4. All exposed piping and fittings shall be chrome-plated or stainless steel. Furnish and install stops on all hot and cold water lines at equipment.
5. Provide shut-off valves and unions in all gas, steam and condensate lines at each connection to equipment.
6. All piping penetrations through walls shall be a minimum of 6" above the floor.
7. Provide 3/4" Watts model U5BLP pressure reducing valve on supply line to dishwasher.
8. Provide check valves on supplies to hose sprays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

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- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

- E. Install wall-mounting fixtures with tubular waste piping attached to supports.

- F. Install counter-mounting fixtures in and attached to casework.
- G. Install fixtures level and plumb according to roughing-in drawings.
- H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- K. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- L. Install toilet seats on water closets.
- M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- Q. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

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- R. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- S. Set bathtubs and service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
- T. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."
- U. All plumbing fixtures are to be mounted at the height specified on the Architectural drawings.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

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3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.
- D. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

3.8 PLUMBING FIXTURE SCHEDULE

- WC-1 Water Closet (Floor Mounted, Sensor Flush Valve, ADA Compliant): Kohler K-4386, Highcliff Toilet, vitreous china, 1.6 gallon flush. Elongated bowl design, 17-1/2" high, siphon jet flushing, 2-1/4" passageway, 1-1/2" top and 52048 bolt caps. Sloan 111 ES-S hard wired sensor operated flush valve. Provide transformers as noted on the drawing. Provide low voltage wiring between transformer and flush valves.
- WC-2 Water Closet (Floor Mounted, Flush Valve, ADA Compliant): Kohler K-4386, Highcliff Toilet, vitreous china, 1.6 gallon flush. Elongated bowl design, 17-1/2" high, siphon jet flushing, 2-1/4" passageway, 1-1/2" top and 52048 bolt caps. Sloan Regal-XL-111-ADA 1.6 gallon flush valve.
- U-1 Urinal: Kohler K-5016-ET Dexter vitreous china, wall hung elongated urinal with 3/4" top spud; Sloan 1186-1.0 ES-S hard wired sensor operated flush valve. Provide transformers as noted on the drawing. Provide low voltage wiring between transformer and flush valves.
- L-1 Lavatory (Counter Mounted, Oval, Sensor Faucet): Kohler K-2196-4, Pennington, 20" x 17" oval, vitreous china, self-rimming lavatory, with front overflow and 4" centers drilling. Chicago 116.103.21.1FC hard wired sensor faucet, rigid goose neck spout with 1.6 gpm FC laminar flow control and plain end spout ring and 4" cover plate. Provide transformers as indicated on the drawings. Provide low voltage wiring between transformer and faucets. Flexible stainless steel supplies with loose key angle stops. Chicago 327A open grid drain and cast brass P-trap with clean-out plug.
- L-5 Lavatory (Wall Hung, Sensor Faucet): Kohler K-2030, Greenwich, 20"x18" "D" shaped bowl, vitreous china, wall hung lavatory with front overflow and 8" centers drilling. Chicago 116.103.21.1FC hard wired sensor faucet,

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- rigid goose neck spout with 1.6 gpm FC laminar flow control and plain end spout ring and 4" cover plate. Provide transformers as indicated on the drawings. Provide low voltage wiring between transformer and faucets. Chicago 327A open grid drain and cast brass P-trap with clean-out plug. Smith 0700 concealed arm chair carrier with foot support. Provide ADA compliant under counter piping wrap by Truebro, Lav Guard series in China white. See architectural interior elevations for mounting height.
- L-6 Lavatory (Wall Hung, Sensor Faucet): Kohler K-2030, Greenwich, 20"x18" "D" shaped bowl, vitreous china, wall hung lavatory with front overflow and 8" centers drilling. Chicago 116.101.21.1FC hard wired sensor faucet, rigid spout with 1.6 gpm FC laminar flow control and plain end spout ring and 4" cover plate. Provide transformers as indicated on the drawings. Provide low voltage wiring between transformer and faucets. Chicago 327A open grid drain and cast brass P-trap with clean-out plug. Smith 0700 concealed arm chair carrier with foot support. Provide ADA compliant under counter piping cover. See architectural interior elevations for mounting height.
- L-7 Lavatory (Integral with countertop, Sensor Faucet): Rough-in and connect, Provide: Chicago 116.101.21.1FC hard wired sensor faucet, rigid spout with 1.6 gpm FC laminar flow control and plain end spout ring and 4" cover plate. Provide transformers as indicated on the drawings. Provide low voltage wiring between transformer and faucets. Chicago 327A open grid drain and cast brass P-trap with clean-out plug. Provide ADA compliant under counter piping cover.
- S-9 Kitchen Sink (Counter Mounted, Double Compartment): Just DL-2131-A-GR 21" x 33" x 7-1/2" deep, 18-gauge, type 304 stainless steel, counter mounted sink with 8" centers drilling. CP-1100 kitchen faucet, lever handles, laminar flow outlet. Flexible stainless steel supplies with loose key angle stops. Just J-35 stainless steel cup strainer and cast brass P-trap with clean-out plug.
- SS-1 Service Sink (Floor Mounted, Corner): Kohler K6710, Whitby, 28 x 28-inch, enameled cast iron floor-mounted corner model, K9146-3" drain with strainer, No. K8940 removable vinyl-coated rim guard; Chicago 897 faucet with vacuum breaker, screwdriver stops in shanks, 5 foot rubber hose and 853 wall hook.

END OF SECTION 224000

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SECTION 23 0100 - MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

- A. The General Conditions of the Contract, with the amendments, supplements, forms and requirements in Division 1, and herewith made a part of this Division.
- B. All sections of Division 21, 22, & 23 shall comply with the Mechanical General Requirements. The standards established in this section as to quality of materials and equipment, the type and quality of workmanship, mode of operations, safety rules, code requirements, etc., shall apply to all sections of this Division as though they were repeated in each Division.
- C. Mechanical equipment that is pre-purchased if any will be assigned to the Mechanical Contractor. By assignment to the Mechanical Contractor, the Mechanical Contractor shall accept and installed the equipment and provide all warranties and guarantees as if the Mechanical Contractor had purchased the equipment.
- D. Construction Indoor-Air Quality Management
 - 1. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
 - a. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
 - b. Replace all air filters immediately prior to occupancy.

1.2 SCOPE OF WORK

- A. The project described herein is the USU TAGGERT STUDENT CENTER SKYROOM REMODEL. This work shall include all labor, materials, equipment, fixtures, and devices for the entire mechanical work and a complete operating and tested installation as required for this project.
- B. This Division will schedule the boiler inspection and pay for all costs associated with certifying the boiler with the state.

1.3 CODES & ORDINANCES

- A. All work shall be executed in accordance with all underwriters, public utilities, local and state rules and regulations applicable to the trade affected. Should any change in the plans and Specifications be required to comply with these regulations, the Contractor shall

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notify the Architect before the time of submitting his bid. After entering into contract, the Contractor will be held to complete all work necessary to meet these requirements without extra expense to the Owner. Where work required by drawings or specifications is above the standard required, it shall be done as shown or specified.

B. Applicable codes:

1. Utah Boiler and Pressure Vessel Rules and Regulations-2023 Edition
2. International Building code- 2021 Edition
3. International Mechanical Code- 2021 Edition
4. International Plumbing Code- 2021 Edition
5. International Fire Code- 2021 Edition

6. International Energy Code- 2021 Edition
7. International Fuel Gas Code- 2021 Edition
8. National Electrical Code- 2020 Edition

1.4 INDUSTRY STANDARDS

A. All work shall comply with the following standards.

1. Associated Air Balance council (AABC)
2. Air Conditioning and Refrigeration Institute (ARI)
3. Air Diffusion council (ADC)
4. Air Movement and Control Association (AMCA)
5. American Gas Association (AGA)
6. American National Standards Institute (ANSI)
7. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
8. American Society of Mechanical Engineers (ASME)
9. American Society of Testing Materials (ASTM)
10. American Water Works Association (AWWA)
11. Cooling Tower Institute (CTI)
12. ETL Testing Laboratories (ETL)
13. Institute of Electrical and Electronic Engineers (IEEE)

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14. Hydronics Institute (HI)
15. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
16. National Fire Protection Association (NFPA)
17. National Electrical Code (NEC)
18. National Electrical Manufacturers Association (NEMA)
19. National Electrical Safety code (NESC)
20. Utah safety Standard (OSHA), Utah State Industrial Council.
21. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
22. Underwriters Laboratories (UL)
23. Tubular Exchanger Manufacturers Association, Inc. (TEMA)
24. Heat Exchanger Institute (HEI)
25. Hydraulic Institute (HI)
26. Thermal Insulation Manufacturer=s Association (TIMA)
27. Scientific Apparatus Makers Association (SAMA)

B. Compliance Verification:

1. All items required by code or specified to conform to the ASME code shall be stamped with the ASME seal.
2. Form U-1, the manufacturer=s data report for pressure vessels, is to be included in the Operation and Maintenance Manuals. National Board Register (NBR) numbers shall be provided where required by code.
3. Manufactured equipment which is represented by a UL classification and/or listing, shall bear the UL or equivalent ETL label.

1.5 UTILITIES & FEES

- A. All fees for permits required by this work will be paid by this division. The contractor shall obtain the necessary permits to perform this work. Unless noted otherwise, all systems furnished and or installed by this Contractor, shall be complete with all utilities, components, commodities, and accessories required for a fully functioning system. This Contractor shall furnish smoke generators when required for testing, furnish glycol for glycol piping systems, full load of salt to fill brine tank for water softening system, furnish cleaners and water treatment additives.

1.6 SUBMITTALS AND SHOP DRAWINGS

- A. General: As soon as possible after the contract is awarded, but in no case more than 45 calendar days thereafter, the Contractor shall submit to the Architect manufacturer's data on products and materials to be used in the installation of mechanical systems for this project. The review of the submitted data will require a minimum of **14 days**. The first day starts after the day they are received in the engineer's office to which the project is being constructed from. If the Contractors schedule requires return of submitted literature in less than the allotted time, the Contractor shall accelerate his submittal delivery date. The Contractor shall resubmit all items requiring re-review within **14 days** of returned submittals. Refer to each specification section for items requiring submittal review. **If the re-submittal is returned a 2nd time for correction the Contractor will provide the specific equipment that is specified on the drawings and/or the specifications.** Written approval of the Owner's Representative shall be obtained before installing any such equipment or materials for the project.
- B. Review by the Owner's Representative is for general conformance of the submitted equipment to the project specification. **In no way** does such review relieve this Contractor of his obligation to furnish equipment and materials that comply in detail to the specification **nor does it relieve** the Contractor of his obligation to determine actual field dimensions and conditions that may affect his work. **Regardless of any items overlooked** by the submittal review, the requirements of the contract drawings and specifications **must be followed** and are not waived or superseded **in any way** by the review.
- C. By description, catalog number, and manufacturer's names, standards of quality have been established by the Architect and the Engineer for certain manufactured equipment items and specialties that are to be furnished by this Division. Alternate products and equipment may be proposed for use only if specifically named in the specifications or if given written prior approval in published addenda. Design equipment is the equipment listed on the drawings or if not listed on the drawings is the equipment first named in the specifications.
- D. If the Engineer is required to do additional design work to incorporate changes caused by submitting equipment or products, different than the design equipment specified, as defined above, the contractor shall reimburse the engineer for additional time and expenses at the engineer's current, recognized, hourly rates.
- E. Submittal Format: At the contractor's discretion, project submittals may be in either of the formats described in the following paragraphs but mixing the two formats is not acceptable.
 - 1. Hardcopy Submittal Format: **Six (6)** copies of the descriptive literature covering products and materials to be used in the installation of mechanical systems for this project will be provided for review. The submittals shall be prepared in an orderly manner, contained in a 3-ring loose-leaf binder with index and identification tab for each item or group of items and for each specification section. All items shall be submitted at one time except automatic temperature control drawings and seismic restraint drawings which may be submitted separately within **120 days** of the contract award date. Partial submittals will not be reviewed until the complete submittal is received.

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- a. Submitted literature shall bear the Contractor's stamp, indicating that he has checked all equipment being submitted; that each item will fit into the available space with the accesses shown on the drawings; and, further, that each item conforms to the capacity and quality standards given in the contract documents.
 - b. Submitted literature shall clearly indicate performance, quality, and utility requirements; shall show dimension and size of connection points; and shall include derating factors that were applied for each item of equipment to provide capacity at job site elevation. Temperature control submittals shall include piping and wiring diagrams, sequence of operation and equipment. Equipment must fit into the available space with allowance for operation, maintenance, etc. Factory piped and wired equipment shall include shop drawings for all internal wiring and piping furnished with the unit.
 - c. Submitted literature shall clearly show all required field install wiring, piping, and accessory installations required by the Contractor to provide a complete operating system.
2. Electronic Submittal Format: Identify and incorporate information in each electronic submittal file as follows:
- a. All items shall be submitted at one time except automatic temperature control drawings and seismic restraint drawings which may be submitted separately within **120 days** of the contract award date. Partial submittals will not be reviewed until the complete submittal is received.
 - b. Submitted electronic file shall bear the Contractor's stamp, indicating that he has checked all equipment being submitted; that each item will fit into the available space with the accesses shown on the drawings; and, further, that each item conforms to the capacity and quality standards given in the contract documents.
 - c. Submitted electronic file shall clearly indicate performance, quality, and utility requirements; shall show dimension and size of connection points; and shall include derating factors that were applied for each item of equipment to provide capacity at job site elevation. Temperature control submittals shall include piping and wiring diagrams, sequence of operation and equipment. Equipment must fit into the available space with allowance for operation, maintenance, etc. Factory piped and wired equipment shall include shop drawings for all internal wiring and piping furnished with the unit.
 - d. Submitted electronic file shall clearly show all required field install wiring, piping, and accessory installations required by the Contractor to provide a complete operating system.
 - e. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - f. Name file with submittal number or other unique identifier, including revision identifier.
 - g. Electronic file shall be completely electronically searchable or it will be rejected.**
 - h. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by:
 - 1) Architect.**
 - i. Transmittal Form for Electronic Submittals:

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- 1) Use one of the following options acceptable to the Owner;
 - a) **Software-generated form from electronic project management software.**
 - b) **Electronic form.**
- 2) The Electronic Submittal shall contain the following information:
 - a) Project name.
 - b) Date.
 - c) Name and address of Architect.
 - d) Name of Construction Manager.
 - e) Name of Contractor.
 - f) Name of firm or entity that prepared submittal.
 - g) Names of subcontractor, manufacturer, and supplier.
 - h) Category and type of submittal.
 - i) Submittal purpose and description.
 - j) Specification Section number and title.
 - k) Specification paragraph number or drawing designation and generic name for each of multiple items.
 - l) Drawing number and detail references, as appropriate.
 - m) Location(s) where product is to be installed, as appropriate.
 - n) Related physical samples submitted directly.
 - o) Indication of full or partial submittal.
 - p) Transmittal number[, numbered consecutively].
 - q) Submittal and transmittal distribution record.
 - r) Other necessary identification.
 - s) Remarks.
- j. Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - 1) Project name.
 - 2) Number and title of appropriate Specification Section.
 - 3) Manufacturer name.
 - 4) Product name.

1.7 DRAWINGS AND MEASUREMENTS

- A. Construction Drawings: The contract document drawings show the general design, arrangements, and extent of the system. In certain cases, the drawings may include details that show more nearly exact locations and arrangements; however, the locations, as shown diagrammatically, are to be regarded as general.
- B. It shall be the work of this Section to make such slight alterations as may be necessary to make adjustable parts fit to fixed parts, leaving all complete and in proper shape when done. All dimensions given on the drawings shall be verified as related to this work and with the Architect's office before work is started.
- C. This Section shall carefully study building sections, space, clearances, etc., and then provide offsets in piping or ductwork as required to accommodate the building structure without additional cost to the Owner. In any case and at any time during the construction process, a change in location required by obstacles or the installation of other trades not shown on the mechanical plans shall be made without charge.

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- D. The drawings shall not be scaled for roughing in measurements nor shall they be used as shop drawings. Where drawings are required for these purposes or where drawings must be made from field measurements, the Contractor shall take the necessary measurements and prepare the drawings. Shop drawings of the various subcontractors shall be coordinated to eliminate all interferences and to provide sufficient space for the installation of all equipment, piping, ductwork, etc.
- E. The drawings and specifications have been prepared to supplement each other and they shall be interpreted as an integral unit with items shown on one and not the other being furnished and installed as though shown and called out on both.
- F. Coordination Drawings: The contractor shall provide coordination drawings for mechanical rooms, fan rooms, equipment rooms, and congested areas to eliminate conflicts with equipment, piping, or work of other trades. The drawings shall be a minimum scale of 1/4 inch= 1 foot and of such detail as may be required by the Engineer to fully illustrate the work. These drawings shall include all piping, conduit, valves, equipment, and ductwork.
- G. Sheet-metal shop drawings will be required for all ductwork in the entire building. These drawings will show all ductwork in the entire building and shall be coordinated with architectural, structural and electrical portions of the project. The contractor shall specifically obtain copies of the structural shop drawings and shall coordinate the ductwork shop drawings with approved structural members. These drawings shall be submitted to the engineer for review prior to any fabrication. The contractor is responsible for all modifications necessary to accommodate duct installation within the structural, architectural and electrical restrictions. These drawings, once reviewed by the engineer, will be made available to all mechanical, electrical, and fire sprinkler subcontractors to coordinate installation of their work.

1.8 CONTRACTOR'S USE OF BUILDING EQUIPMENT

- A. The Contractor may use equipment such as electric motors, fans, heat exchangers, filters, etc., with the written permission of the Owner. As each piece of equipment is used (such as electric motors and fans), maintenance procedures approved by the manufacturer are to be followed. A careful record is to be kept of the length of the time the equipment is used, maintenance procedures followed, and any difficulty encountered. The record is to be submitted to the Owner upon acceptance. All fan belts and filter media (such as bearings) shall be carefully inspected just prior to acceptance. Any excessive wear noted shall require replacement. New filter media shall be installed in air handlers at the time systems are turned over to the owner.

1.9 EXISTING CONDITIONS

- A. The Contractor shall carefully examine all existing conditions that might affect the mechanical system and shall compare these conditions with all drawings and specifications for work included under this contract. He shall, at such time, ascertain and check all conditions that may affect his work. No allowance shall subsequently be made in his behalf for an extra expense incurred as a result of his failure or neglect to make such examination. This Contractor shall include in his bid proposal all necessary allowances to

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repair or replace any item that will remain or will be removed, and any item that will be damaged or destroyed by new construction.

- B. The Contractor shall remove all abandoned piping, etc., required by new construction and cap or plug openings. No capping, etc., shall be exposed in occupied areas. All openings of items removed shall be sealed to match adjacent surfaces.
- C. The Contractor shall verify the exact location of all existing services, utilities, piping, etc., and make connections to existing systems as required or as shown on the drawings. The exact location of each utility line, together with size and elevation, shall be established before any on-site lines are installed. Should elevation or size of existing main utility lines make connections to them impossible as shown on drawings, then notification of such shall immediately be given to the Owners Representative for a decision.

1.10 EQUIPMENT CAPACITIES

- A. Capacities shown for equipment in the specifications and on the drawings are the minimum acceptable. No equipment shall be considered as an alternate that has capacities or performance less than that of design equipment.
- B. All equipment shall give the specified capacity and performance at the job-site elevation. Manufacturers' standard ratings shall be adjusted accordingly. All capacities and performances listed on drawings or in specifications are for job-site conditions.

1.11 SEISMIC REQUIREMENTS FOR EQUIPMENT

- A. All equipment shall be furnished structurally adequate to withstand seismic forces as outlined in the International Building Code. Refer to section Mechanical Vibration Controls and Seismic Restraints. Equipment bases shall be designed for direct attachment of seismic snubbers and/or seismic anchors.

1.12 COOPERATION WITH OTHER TRADES

- A. The Contractor shall refer to other drawings and parts of this specification that cover work of other trades that is carried on in conjunction with the mechanical work such that all work can proceed without interference resulting from lack of coordination.
- B. The Contractor shall properly size and locate all openings, chases, sleeves, equipment bases, and accesses. He shall provide accurate wiring diagrams to the Electrical Contractor for all equipment furnished under this Division.
- C. The ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of conflict, the installation of the mechanical equipment and piping shall be in the following order: plumbing, waste, and soil lines; supply, return, and exhaust ductwork; water piping; medical gases; fire protection piping; and pneumatic control piping.
- D. The mechanical Contractor shall insure that the installation of all piping, ducts and equipment is in compliance with Articles 110-16 and 384-4 of the National Electrical Code

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relative to proper clearances in front of and over all electrical panels and equipment. No piping or ductwork will be allowed to run over electrical panel.

1.13 RESPONSIBILITY OF CONTRACTOR

- A. The Contractor is responsible for the installation of a satisfactory piece of work in accordance with the true intent of the drawings and specifications. He shall provide, as a part of his work and without expense, all incidental items required even though these items are not particularly specified or indicated. The installation shall be made so that its several component parts will function together as a workable system and shall be left with all equipment properly adjusted and in working order. The Contractor shall familiarize the Owner's Representative with maintenance and lubrication instructions as prepared by the Contractor and shall explain and fully instruct him relative to operating, servicing, and maintenance of them.
- B. If a conflict arises between the drawings and the specifications the most stringent procedure/action shall be followed. A clarification to the engineer will help to determine the course of action to be taken. If a conflict arises between specification sections the engineer will determine which course of action is to be followed.

1.14 PIPE AND DUCT OPENINGS AND EQUIPMENT RECESSES

- A. Pipe and duct chases, openings, and equipment recesses shall be provided by others only if shown on architectural or structural drawings. All openings for the mechanical work, except where plans and specifications indicate otherwise, shall be provided as work of this Division. Include openings information with coordination drawings.
- B. Whether chases, recesses, and openings are provided as work of this Division or by others, this Contractor shall supervise their construction and be responsible for the correct size and location even though detailed and dimensioned on the drawings. This Contractor shall pay for all necessary cutting, repairing, and finishing if any are left out or incorrectly made. All necessary openings thru existing walls, ceilings, floors, roofs, etc. shall be provided by this Contractor unless indicated otherwise by the drawing and/or specifications.

1.15 UNFIT OR DAMAGED WORK

- A. Any part of this installation that fails, is unfit, or becomes damaged during construction, shall be replaced or otherwise made good. The cost of such remedy shall be the responsibility of this Division.

1.16 WORKMANSHIP

- A. Workmanship shall be the best quality of its kind for the respective industries, trades, crafts, and practices, and shall be acceptable in every respect to the Owner's representative. Nothing contained herein shall relieve the Contractor from making good and perfect work in all details in construction.

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1.17 SAFETY REGULATION

- A. The Contractor shall comply with all local, Federal, and OSHA safety requirements in performance with this work. (See General Conditions). This Contractor shall be required to provide equipment, supervision, construction, procedures, and all other necessary items to assure safety to life and property.

1.18 ELECTRICAL SERVICES

- A. All equipment control wiring and all automatic temperature control wiring including all necessary contacts, relays, and interlocks, whether low or line voltage, except power wiring, shall be furnished and installed as work of this Division unless shown to be furnished by Division 26. All such wiring shall be in conduit as required by electrical codes. Wiring in the mechanical rooms, fans rooms and inaccessible ceilings and walls shall be installed in conduit as well. Installation of any and all wiring done under Division 21, 22 and 23 shall be in accordance with the requirements of Division 26, Electrical.
- B. All equipment that requires an electrical connection shall be furnished so that it will operate properly and deliver full capacity on the electrical service available.
- C. Refer to the electrical control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment.
- D. The Mechanical Contractor must coordinate with the Electrical Contractor to insure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

1.19 WORK, MATERIALS, AND QUALITY OF EQUIPMENT

- A. Unless otherwise specified, all materials shall be new and of the best quality of their respective kinds and all labor shall be done in a most thorough and workmanlike manner.
- B. Products or equipment of any of the manufacturers cited herein or any of the products approved by the Addenda may be used. However, where lists of products are cited herein, the one first listed in the design equipment used in drawings and schedules to establish size, quality, function, and capacity standards. If other than design equipment is used, it shall be carefully checked for access to equipment, electrical and control requirements, valving, and piping. Should changes or additions occur in piping, valving, electrical work, etc., or if the work of other Contractors would be revised by the alternate equipment, the cost of all changes shall be borne as work of this Division.
- C. The Execution portions of the specifications specify what products and materials may be used. Any products listed in the Product section of the specification that are not listed in the Execution portion of the specification may not be used without written approval by the Engineer.
- D. The access to equipment shown on the drawings is the minimum acceptable space requirements. No equipment that reduces or restricts accessibility to this or any other equipment will be considered.

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- E. All major items of equipment are specified in the equipment schedules on the drawings or in these specifications and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory installation.
- F. All welders shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code, latest Edition.

1.20 PROTECTION AGAINST WEATHER AND STORING OF MATERIALS

- A. All equipment and materials shall be properly stored and protected against moisture, dust, and wind. Coverings or other protection shall be used on all items that may be damaged or rusted or may have performance impaired by adverse weather or moisture conditions. Damage or defect developing before acceptance of the work shall be made good at the Contractor's expense.
- B. All open duct and pipe openings shall be adequately covered at all times.

1.21 INSTALLATION CHECK

- A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment indicated in the equipment schedule and the seismic supplier shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the Engineer.
- B. Each equipment supplier's representative shall furnish to the Owner, through the Engineer, a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and, (4) has been operated under full load conditions and that it operated satisfactorily.
- C. All costs for this work shall be included in the prices quoted by equipment suppliers.

1.22 EQUIPMENT LUBRICATION

- A. The Contractor shall properly lubricate all pieces of equipment before turning the building over to the Owner. A linen tag shall be attached to each piece of equipment, showing the date of lubrication and the lubricant used. No equipment shall be started until it is properly lubricated.
- B. Necessary time shall be spent with the Owner's Representative to thoroughly familiarize him with all necessary lubrications and maintenance that will be required of him.
- C. Detergent oil as used for automotive purposes shall not be used for this work.

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1.23 CUTTING AND PATCHING

- A. No cutting or drilling in structural members shall be done without written approval of the Architect. The work shall be carefully laid out in advance, and cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces necessary for the mechanical work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by professional plasterers, masons, concrete workers, etc., and all such work shall be paid for as work of this Division.
- B. When concrete, grading, etc., is disturbed, it shall be restored to original condition as described in the applicable Division of this Specification.

1.24 EXCAVATION AND BACKFILLING

- A. All necessary excavations and backfilling for the Mechanical phase of this project shall be provided as work of this Division. Trenches for all underground pipelines shall be excavated to the required depths. The bottom of trenches shall be compacted hard and graded to obtain required fall. Backfill shall be placed in horizontal layers, not exceeding 12 inches in thickness, and properly moistened. Each layer shall be compacted, by suitable equipment, to a density of not less than 95 percent as determined by ASTM D-1557. After pipelines have been tested, inspected, and approved, the trench shall be backfilled with selected material. Excess earth shall be hauled from the job site. Fill materials approved by the Architect shall be provided as work of this Division.
- B. No trenches shall be cut near or under any footings without consultation first with the Architect's office. Any trenches or excavations more than 30 inches deep shall be tapered, shored, covered, or otherwise made absolutely safe so that no vehicle or persons can be injured by falling into such excavations, or in any way be harmed by cave-ins, shifting earth, rolling rocks, or by drowning. This protection shall be extended to all persons approaching excavation related to this work whether or not such persons are authorized to be in the vicinity of the construction.

1.25 ACCESS

- A. Provide access doors in walls, ceilings and floors by this division unless otherwise noted. For access to mechanical equipment such as valves, dampers, VAV boxes, fans, controls, etc. Refer to Division 8 for door specifications. All access doors shall be 24" x 24" unless otherwise indicated or required. Coordinate location of doors with the Architect prior to installation. . If doors are not specified in Division 8, provide the following: Doors in ceilings and wall shall be equal to JR Smith No. 4760 bonderized and painted. Doors in file walls shall be equal to JR Smith No. 4730 chrome plated. Doors in floors shall be equal to JR Smith No. 4910
- B. Valves: Valve must be installed in locations where access is readily available. If access is compromised, as judged by the Mechanical Engineer, these valves shall be relocated where directed at the Contractors expense.
- C. Equipment: Equipment must be installed in locations and orientations so that access to all components requiring service or maintenance will not be compromised. If access is

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compromised, as judged by the Mechanical Engineer, the contractor shall modify the installation as directed by the Engineer at the Contractors expense.

- D. It is the responsibility of this division to install terminal boxes, valves and all other equipment and devices so they can be accessed. If any equipment or devices are installed so they cannot be accessed on a ladder a catwalk and ladder system shall be installed above the ceiling to access and service this equipment.

1.26 CONCRETE BASES AND INSERTS

- A. Bases: The concrete bases shall be provided and installed as work by this division. This Division shall be responsible for the proper size and location of bases and shall furnish all required anchor bolts and sleeves with templates to be installed as work of Division 3, Concrete.
- B. All floor-mounted mechanical equipment shall be set on 6-inch high concrete bases, unless otherwise noted or shown on drawings. Such bases shall extend 6 inches beyond equipment or mounting rails on all sides or as shown on the drawings and shall have a 1-inch beveled edge all around.
- C. Inserts: Where slotted or other types of inserts required for this work are to be cast into concrete, they shall be furnished as work of this Division
- D. Concrete inserts and pipe support systems shall be equal to Unistrut P3200 series for all piping where more than one pipe is suspended at a common location. Spacing of the inserts shall match the size and type of pipe and of ductwork being supported. The Unistrut insert and pipe support system shall include all inserts, vertical supports, horizontal support members, clamps, hangers, rollers, bolts, nuts, and any other accessory items for a complete pipe-supporting system.

1.27 CLEANING AND PAINTING

- A. Cleaning: After all tests and adjustments have been made and all systems pronounced satisfactory for permanent operation, this Contractor shall clean all exposed piping, ductwork, insulated members, fixture, and equipment installed under this Section and leave them ready for painting. He shall refinish any damaged finish and leave everything in proper working order. The Contractor shall remove all stains or grease marks on walls, floors, glass, hardware, fixtures, or elsewhere, caused by his workman or for which he is responsible. He shall remove all stickers on plumbing fixtures, do all required patching up and repair all work of others damaged by this division of the work, and leave the premises in a clean and orderly condition.
- B. Painting: Painting of exposed pipe, insulated pipe, ducts, or equipment is work of Division 9, Painting.
- C. Mechanical Contractor: All equipment which is to be furnished in factory prefinished conditions by the mechanical Contractor shall be left without mark, scratch, or impairment to finish upon completion of job. Any necessary refinishing to match original shall be done. Do not paint over nameplates, serial numbers, or other identifying marks.

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- D. Removal of Debris, Etc: Upon completion of this division of the work, remove all surplus material and rubbish resulting from this work, and leave the premises in a clean and orderly condition.

1.28 CONTRACT COMPLETION

- A. Incomplete and Unacceptable Work: If additional site visits or design work is required by the Engineer or Architect because of the use of incomplete or unacceptable work by the Contractor, then the Contractor shall reimburse the Engineer and Architect for all additional time and expenses involved.
- B. Maintenance Instructions: The Contractor shall furnish the Owner complete printed and illustrated operating and maintenance instructions covering all units of mechanical equipment, together with parts lists.
- C. Instructions To Owner's Representatives: In addition to any detailed instructions called for, the mechanical Contractor must provide, without expense to the Owner, competent instructors to train the Owner's representatives who will be in charge of the apparatus and equipment, in the care, adjustment, and operation of all parts on the heating, air conditioning, ventilating, plumbing, fire protection, and automatic temperature control equipment. Instruction dates shall be scheduled at time of final inspection. A written report specifying times, dates, and name of personnel instructed shall be forwarded to the Architect. A minimum of four 8-hour instruction periods shall be provided. The instruction periods will be broken down to shorter periods when requested by the Owner. The total instruction hours shall not reduced. The ATC Contractor shall provide 4 hours of instructions. The remaining hours shall be divided between the mechanical and sheet metal Contractor.
- D. Guarantee: By the acceptance of any contract award for the work herein described or shown on the drawings, the Contractor assumes the full responsibility imposed by the guarantee as set forth herein and in the General Conditions, and should protect himself through proper guarantees from equipment and special equipment Contractors and from subcontractors as their interests may appear.
- E. The guarantee so assumed by the Contractor and as work of this Section is as follows:
 - 1. That the entire mechanical system, including plumbing, heating, and air-conditioning system shall be quiet in operation.
 - 2. That the circulation of water shall be complete and even.
 - 3. That all pipes, conduit, and connections shall be perfectly free from foreign matter and pockets and that all other obstructions to the free passage of air, water, liquid, sewage, and vent shall be removed.
 - 4. That he shall make promptly and free of charge, upon notice from the Owner, any necessary repairs due to defective workmanship or materials that may occur during a period of one year from date of Substantial Completion.
 - 5. That all specialties, mechanical, and patent devices incorporated in these systems shall be adjusted in a manner that each shall develop its maximum efficiency in the

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operation of the system; i.e., diffusers shall deliver the designed amount of air shown on drawings, thermostats shall operate to the specified limits, etc.

6. All equipment and the complete mechanical, ductwork, piping and plumbing systems shall be guaranteed for a period of one year from the date of the Architect's Certificate of Substantial Completion, this includes all mechanical, ductwork, piping and plumbing equipment and products and is not limited to boiler, chillers, coils, fans, filters etc. Any equipment supplier not willing to comply with this guarantee period shall not submit a bid price for this project. The Contractor shall be responsible for a 100-percent guarantee for the system and all items of equipment for this period. If the contractor needs to provide temporary heating or cooling to the building and or needs to insure systems are installed properly and or to meet the project schedule the guaranteed of all systems and equipment shall be as indicated above, on year from the date of the Architect's Certificate of Substantial Completion.
7. All filters used during construction shall be replaced just before equipment is turned over to the Owner, and all required equipment and parts shall be oiled. Any worn parts shall also be replaced.
8. If any systems or equipment is used for temporary heating or cooling the systems shall be protected so they remain clean. I.e. if the ductwork systems are used temporary filters and a filter holder (not duct-taped to ducts or grilles) shall be installed to insure the systems and the equipment remain clean.

1.29 CURBS

- A. Unless otherwise noted in these specifications or on the documents all roof curbs for all equipment are to be provided by Division 22 and 23.

1.30 TEST RUN

- A. The Mechanical Contractor shall operate the mechanical system for a minimum of 30 days to prove the operation of the system.

1.31 EQUIPMENT STARTUP AND CHECKOUT:

- A. Each major piece of equipment shall be started and checked out by an authorized representative of the equipment manufacturer. A certificate indicating the equipment is operating to the satisfaction of the manufacturer shall be provided and shall be included in the commissioning report.
- B. This contractor shall coordinate commissioning procedures and activities with the commissioning agent.

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1.32 DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
- B. Proceed with demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- C. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
- D. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
- E. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
- F. Maintain adequate ventilation when using cutting torches.
- G. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
- H. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
- I. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- J. Dispose of demolished items and materials promptly.
- K. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- L. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- M. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- N. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

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- O. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- P. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

1.33 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

END OF SECTION 23 0100

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SECTION 230150 – TEMPORARY USE OF EQUIPMENT AND SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes requirements for temporary use of equipment and systems and any other items that are used during the construction of the project.

1.2 EQUIPMENT OR SYSTEMS NEEDED TO OPERATE BEFORE CONTRACT COMPLETION

- A. If the contractor needs to provide temporary heating or cooling to the building and or needs to insure systems are installed properly for start up and or to meet the project schedule the guaranteed of all systems and equipment shall be for one year from the date of the Architect's Certificate of Substantial Completion.
- B. All equipment and the complete mechanical, ductwork, piping and plumbing systems shall be guaranteed for a period of one year from the date of the Architect's Certificate of Substantial Completion, this includes all mechanical, ductwork, piping and plumbing equipment and products and is not limited to boiler, chillers, coils, fans, filters etc. Any contractor or equipment supplier who is not willing to comply with this guarantee period shall not submit a bid price for this project. The Contractor shall be responsible for a 100-percent guarantee for the systems and all items of equipment for this period.
- C. All filters used during construction shall be replaced just before equipment is turned over to the Owner, and all required equipment and parts shall be oiled. Any worn parts shall also be replaced.
- D. If any systems or equipment is used for temporary heating or cooling the systems shall be protected so they remain clean. I.e. if the ductwork systems are used temporary filters and a filter holder (not duct-taped to ducts or grilles) shall be installed to insure the systems and the equipment remain clean. All return air openings shall be protected with a metal filter frame and filters.

1.3 TEMPORARY EQUIPMENT OR SYSTEM SUBMITTALS

- A. If it is determined by the project or contractor that equipment or systems are needed to operate to provide heating, cooling or other needed services this division shall submit a document indicating what measures will be taken to insure the safe and proper operation of the equipment, systems and personal associated with the operation, this document shall be submitted to the engineer for approval. This plan shall show connections of equipment, utility hookups (if required) staging areas etc.

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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.
- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
- D. SMACNA: The latest standard from SMACNA shall apply.

1.5 PROJECT CONDITIONS

- A. Temporary Use of equipment or systems: Engage installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use until the facility has been accepted by the owner regardless of previously assigned responsibilities.

1.6 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 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 and cooling units if required with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filters with MERV of **8** at each return air opening in system and remove at end of construction. These filters are to be installed in a filter housing frame and are not to be duct taped. Clean HVAC system as required in Division 01 Section "Closeout Procedures."

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PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate equipment where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify equipment and systems as required by progress of the Work.
 - 1. Locate equipment to limit site disturbance as specified in Division 01 Section "Summary."

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- C. 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.
- D. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

3.3 OPERATION, TERMINATION, AND REMOVAL

- A. Maintenance: Maintain equipment and systems in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar equipment and systems on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- B. Termination and Removal: Remove each temporary facility or equipment when need for its service has ended, when it has been replaced by authorized use of a

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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 equipment that constitute temporary equipment are property of Contractor.
2. At Substantial Completion, repair, renovate, and clean permanent equipment and systems used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

3.4 EQUIPMENT STARTUP AND CHECKOUT:

- A. Each major piece of equipment shall be started and checked out by an authorized representative of the equipment manufacturer at substantial completion. A certificate indicating the equipment is operating to the satisfaction of the manufacturer shall be provided and shall be included in the commissioning report.

END OF SECTION 230150

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SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Concrete bases.
 - 11. Supports and anchorages.
 - 12. Link-Seal

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, and crawlspaces.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces, mechanical equipment rooms, accessible pipe shafts, accessible plumbing chases, and accessible tunnels.

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- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

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- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

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2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, **1/8-inch** maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, **1/8 inch** thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Eslon Thermoplastics.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

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1. Manufacturers:
 - a. Thompson Plastics, Inc.

2.5 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for **250-psig** minimum working pressure at **180 deg F**.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for **150-** or **300-psig** minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 1. Provide separate companion flanges and steel bolts and nuts for **150-** or **300-psig** minimum working pressure as required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and **300-psig** minimum working pressure at **225 deg F**.
- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and **300-psig** minimum working pressure at **225 deg F**.
 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Watts Industries, Inc.; Water Products Div

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.

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- c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
- 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: **0.0239-inch** minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- E. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

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2.9 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: **5000-psi**, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.10 LINK-SEAL MODULAR SEAL PRESSURE PLATES

- A. Link-Seal® modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:
 - 1. Izod Impact - Notched = **2.05ft-lb/in.** per ASTM D-256
 - 2. Flexural Strength @ Yield = **30,750 psi** per ASTM D-790
 - 3. Flexural Modulus = **1,124,000 psi** per ASTM D-790
 - 4. Elongation Break = 11.07% per ASTM D-638
 - 5. Specific Gravity = 1.38 per ASTM D-792
- B. Models LS200-275-300-315 shall incorporate the most current Link-Seal® Modular Seal design modifications and shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which permits increased compressive loading of the rubber sealing element. Models 315-325-340-360-400-410-425-475-500-525-575-600 shall incorporate an integral recess known as a "Hex Nut Interlock" designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware. All pressure plates shall have a permanent identification of the manufacturer's name molded into it.
- C. For fire service, pressure plates shall be steel with 2-part Zinc Dichromate Coating.
- D. Link-Seal® Modular Seal Hardware: All fasteners shall be sized according to latest Link-Seal® modular seal technical data. Bolts, flange hex nuts shall be:
 - 1. 316 Stainless Steel per ASTM F593-95, with a **85,000 psi** average tensile strength.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

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- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
- M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

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- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches** above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC Steel Pipe Sleeves: For pipes smaller than **NPS 6**.
 - b. Steel Sheet Sleeves: For pipes **NPS 6** and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to **2 inches** above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than **6 inches** in diameter.
 2. Install cast-iron "wall pipes" for sleeves **6 inches** and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for **1-inch** annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve.

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Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:

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1. Install unions, in piping **NPS 2** and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping **NPS 2-1/2** and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch** centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

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4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use **3000-psi**, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Miscellaneous Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.9 LINK SEAL

- A. Provide Link Seal at all piping penetrations from the outside.

END OF SECTION 230500

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Company (The).
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Stainless steel.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves.
2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
5. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 23 0517

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SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated or rough-brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type with polished, chrome-plated finish.
 - b. Chrome-Plated Piping: **One-piece, cast-brass** type with polished, chrome-plated finish.
 - c. Insulated Piping: **One-piece, stamped-steel type with chrome-plated finish.**
 - d. Bare Piping 2 inch and Smaller at Wall and Floor Penetrations in Finished Spaces: **One-piece, cast-brass** type with polished, chrome-plated finish.
 - e. Bare Piping Larger than 2 inch at Wall and Floor Penetrations in Finished Spaces: **One-piece, stamped-steel type with polished, chrome-plated finish,**
 - f. Bare Piping 2 inch and Smaller at Ceiling Penetrations in Finished Spaces: **One-piece, cast-brass** type with polished, chrome-plated finish.
 - g. Bare Piping Larger than 2 inch at Ceiling Penetrations in Finished Spaces: **One-piece, stamped-steel type with polished, chrome-plated finish,**
 - h. Bare Piping 2 inch and Smaller in Unfinished Service Spaces: **One-piece, cast-brass**
 - i. Bare Piping Larger than 2 inch in Unfinished Service Spaces: **One-piece, stamped-steel type with polished, chrome-plated finish,**
 - j. Bare Piping 2 inch and Smaller in Equipment Rooms: **One-piece, cast-brass** type with **polished, chrome-plated** finish.
 - k. Bare Piping in Equipment Rooms Larger than 2 inch: **One-piece, stamped-steel type with chrome- or cadmium-plated finish,**

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518

SECTION 230519 - METERS AND GAGES FOR HVAC

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. Liquid-in-glass thermometers.
2. Thermowells.
3. Pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.
7. Flowmeters.

B. Related Sections:

1. Division 23 Section "Facility Natural-Gas Piping" for gas meters.
2. Division 23 Section "Steam and Condensate Heating Piping" for steam and condensate meters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

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1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

1.6 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Palmer Wahl Instrumentation Group.
 - b. Trerice, H. O. Co.
 - c. Weiss Instruments, Inc.
 - d. Weksler.
2. Standard: ASME B40.200.
3. **Case:** Die Cast aluminum or brass; nominal size unless otherwise indicated.
4. Case Form: **Adjustable angle** type unless otherwise indicated, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
5. **Tube:** Glass with magnifying lens and **blue** organic liquid.
6. Tube Background: Satin faced, nonreflective aluminum with permanently etched scale markings graduated in **deg F**.
7. Window: **Glass**.
8. **Stem:** Copper-plated steel, aluminum, stainless steel, or brass designed for thermowell installation. Stem shall be of length to match thermowell insertion length.
 - a. **Design for** Thermowell Installation: Bare stem.
9. Connector: **1-1/4 inches**, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

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2.2 THERMOWELLS

A. Thermowells:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge Div.
 - b. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - c. Ernst Gage Co.
 - d. Marsh Bellofram.
 - e. Miljoco Corp.
 - f. NANMAC Corporation.
 - g. Noshok, Inc.
 - h. Palmer - Wahl Instruments Inc.
 - i. REO TEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Trerice, H. O. Co.
 - l. Weiss Instruments, Inc.
 - m. Weksler
 - n. WIKA Instrument Corporation.
 - o. Winters Instruments.
2. Manufacturers: Same as manufacturer of thermometer being used.
3. Standard: ASME B40.200.
4. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
5. **Material for Use with Copper Tubing: Brass.**
6. **Material for Use with Steel Piping: Brass.**
7. Type: Stepped shank unless straight or tapered shank is indicated.
8. External Threads: **NPS 1/2, NPS 3/4, NPS 1 or NPS 1-1/4** ASME B1.20.1 pipe threads.
9. Internal Threads: **1/2, 3/4, and 1 inch** with ASME B1.1 screw threads.
10. Bore: Diameter required to match thermometer bulb or stem.
11. Insertion Length: Length required to match thermometer bulb or stem.
12. Lagging Extension: Include on thermowells for insulated piping and tubing.
13. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

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2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. KOBOLD Instruments, Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Trerice, H. O. Co.
 - k. Weiss Instruments, Inc.
 - l. Weksler
 - m. WIKA Instrument Corporation.
 - n. Winters Instruments - U.S.
2. Standard: ASME B40.100.
3. **Case:** Liquid-filled type; cast aluminum or drawn steel; **4-1/2-inch** nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated. **NPS 1/4 or NPS 1/2.**
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Satin faced, nonreflective aluminum with permanently etched scale markings graduated in **psi**.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. **Ring: Stainless steel.**
11. **Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.**

B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.

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- c. Ernst Flow Industries.
 - d. KOBOLD Instruments, Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Trerice, H. O. Co.
 - k. Weiss Instruments, Inc.
 - l. Weksler
 - m. WIKA Instrument Corporation.
 - n. Winters Instruments - U.S.
2. Standard: ASME B40.100.
 3. **Case: Liquid-filled, cast aluminum or drawn steel;** diameter with **back** flange for panel surface mounting or front flange for panel recessed mounting. Flanges to include pre-drilled screw holes.
 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 5. Pressure Connection: Brass, with ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated. **NPS 1/4 or NPS 1/2.**
 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 7. Dial: Satin faced, nonreflective aluminum with permanently etched scale markings graduated in **psi** .
 8. Pointer: Dark-colored metal.
 9. Window: **Glass.**
 10. **Ring: Stainless steel.**
 11. **Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.**

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with ASME B1.20.1 pipe threads. Include extension for use on insulated piping. **NPS 1/4 or NPS 1/2 .**

1. **Surge-dampening device: porous-metal-type.**

B. Siphons:

1. **Loop-shaped section: Brass** pipe with pipe threads. **NPS 1/4 or NPS 1/2.**

C. Valves:

1. **Needle: Brass,** with **NPS 1/4 or NPS 1/2** ASME B1.20.1 pipe threads.

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2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Twin City Hose.
8. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Minimum Pressure and Temperature Rating:

E. Core Inserts: Self-sealing synthetic rubber;

1. EPDM (Nordel) for air, water or glycol operation between **30 and 275 deg F.**
2. CR (Neoprene) for air, water, glycol, oil, or gas operation between **-30 to 200 deg F.**

2.6 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.

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7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Furnish the number of test-plug kits given below with the number of thermometers given below, with each kit having one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

1. Low-Range Thermometer: Small, bimetallic insertion type with **1- to 2-inch** diameter dial and tapered-end sensing element. Dial range shall be at least **25 to 125 deg F**.
2. High-Range Thermometer: Small, bimetallic insertion type with **1- to 2-inch** diameter dial and tapered-end sensing element. Dial range shall be at least **0 to 220 deg F**.
3. Pressure Gage: Small, Bourdon-tube insertion type with **2- to 3-inch** diameter dial and probe. Dial range shall be at least **to 200 psig**.
4. Carrying Case: Metal or plastic, with formed instrument padding.
5. **One test-plug kit with:**
 - a. **Two** thermometers.

2.7 FLOWMETERS

A. Orifice Flowmeters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB; Instrumentation and Analytical.
 - b. Armstrong Pumps Inc.; S. A. Armstrong Limited.
 - c. Badger Meter, Inc.; Industrial Div.
 - d. Bell & Gossett; ITT Industries.
 - e. Meriam Process Technologies.
 - f. Spirax Sarco
2. Description: Flowmeter with sensor, hoses or tubing, quick connect hose fittings, valves, indicator, and conversion chart.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Wafer-orifice-type, calibrated, flow-measuring element; for installation between pipe flanges.
 - a. Design: Differential-pressure-type measurement:
 - 1) For HVAC hot water

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- b. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
 - c. Minimum Pressure Rating: **300 psig**.
 - d. Minimum Temperature Rating: **250 deg F**.
5. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected sensor and having two **12-foot** hoses, with carrying case.
- a. Scale: **Gallons per minute**.
 - b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range
6. Conversion Chart: Flow rate data compatible with sensor and indicator.
7. Operating Instructions: Include complete instructions with each flowmeter.

B. Venturi Flowmeters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pump
 - b. Badger Meter, Inc.; Industrial Division
 - c. Bailey-Fischer & Porter Co.
 - d. Flow Design, Inc.
 - e. Gerand Engineering Co.
 - f. Hyspan Precision Products, Inc.
 - g. Leeds & Northrup.
 - h. McCrometer, Inc.
 - i. Preso Meters; a division of Racine Federated Inc.
 - j. Victaulic Company.
 - k. Spirax Sarco
2. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, quick connect hose fittings, valves, indicator, and conversion chart.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.
 - a. **Design:** Differential-pressure-type measurement for **water**.
 - b. Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.
 - c. Minimum Pressure Rating: **250 psig** .
 - d. Minimum Temperature Rating: **250 deg F** .
 - e. End Connections for **NPS 2** and Smaller: Threaded.
 - f. End Connections for **NPS 2-1/2** and Larger: Flanged or welded.
 - g. Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. **Install thermowells:** with socket extending **one-third of pipe diameter** and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions to most readable position.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install needle-valve and snubber in piping for each pressure gage for fluids. Exception: Steam.
- H. Install test plugs in piping tees.
- I. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic boiler.
 - 2. Two inlets and two outlets of each chiller.
 - 3. Inlet and outlet of each hydronic coil in air-handling units.
 - 4. Two inlets and two outlets of each hydronic heat exchanger.
 - 5. Inlet and outlet of each thermal-storage tank.
 - 6. Inlet and outlet of each piece of steam equipment.
- J. Install pressure gages in the following locations:
 - 1. Inlet and discharge of each pressure-reducing valve.
 - 2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
 - 3. Suction and discharge of each pump.

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3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Where indicated on details

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: **30 to 240 deg F.**

B. Scale Range for Air Ducts: **Minus 40 to plus 110 deg F.**

3.6 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water, Condenser-Water, Heating, Hot-Water, Steam and Condensate Piping shall be twice the normal operating pressure of the measured system with gage ranges as follows:

1. **30 in. Hg to 15 psi .**
2. **0 to 30 psi .**
3. **0 to 100 psi .**
4. **0 to 160 psi .**
5. **0 to 200 psi .**
6. **0 to 300 psi .**
7. **0 to 600 psi .**

3.7 FLOWMETER SCHEDULE

A. Flowmeters for Heating, Hot-Water Piping: **Venturi** type.

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SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze ball valves.
 - 2. Iron, single-flange butterfly valves.
 - 3. Bronze lift check valves.
 - 4. Bronze swing check valves.
 - 5. Iron swing check valves.
 - 8. Bronze globe valves.
 - 9. Iron globe valves.
 - 10. Lubricated plug valves.
 - 11. Chainwheels.
- B. Related Sections:
 - 1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.

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- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated. Body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- B. Maintenance data for valves to be included in the operation and maintenance data specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve as listed in SUMMARY from a single source and from a single manufacturer.
- B. Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
 - 4. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.6 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. **Set** angle, and globe valves closed to prevent rattling.

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4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Set butterfly valves closed or slightly open.
 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 2. Handwheel: For valves other than quarter-turn types.
 3. Handlever: For quarter-turn valves NPS 6 and smaller.
 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every **5** plug valves, for each size square plug-valve head.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.

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2. Solder Joint: With sockets according to ASME B16.18.
 - a. **Caution:** Where soldered end connections are used, use solder having a melting point below 840 deg. For, globe, and check valves: below 421 deg. F for ball valves.
 3. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
1. APCO Willamette Valve and Primer Corp.
 2. Babbitt Steam Specialty Company.
 3. Bray Controls.
 4. Center Line.
 5. Cla-Val Company.
 6. Conbraco Industries Inc., Apollo Valves
 7. Crane Co.; Crane Valve Group.
 8. Fisher Valve by Emerson.
 9. Flo Fab Inc.
 10. Flow-Tek Inc.
 11. Grinnell Corporation.
 12. Hammond Valve.
 13. Jamesbury; a subsidiary of Metso Automation.
 14. Jomar International LTD.
 15. Keystone Valve USA, Inc.
 16. Kitz Corp.
 17. Metraflex Company.
 18. Milwaukee Valve Company.
 19. Mueller Steam Specialty.

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- 20. NIBCO Inc.
- 21. Red-White Valve Corp.
- 22. Spence Strainers International.
- 23. Stockham Valves and Fittings, Inc.
- 24. Tyco Fire/Shurjoint Piping Products.
- 25. Tyco/Pentair LTD.
- 26. Val-Matic Valve & Mfg. Corp.
- 27. Victaulic Company.
- 28. Watts Regulator Company.

2.4 BRONZE BALL VALVES

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

- 1. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.5 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange (Lug) Butterfly Valves:

- 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. **Disc: Nylon 11 coated ductile iron.**

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B. 175 CWP, Iron, Single-Flange (Lug) Butterfly Valves:

1. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 175 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. **Disc:** Nylon 11 coated ductile iron.

C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and **Nylon 11 coated ductile Iron** Disc:

1. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. **Disc:** Nylon 11 coated ductile iron.

D. 250 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and **Nylon 11 coated ductile Iron** Disc:

1. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 250 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. **Disc:** Nylon 11 coated ductile iron.

2.6 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valve:

1. Description:

- a. Standard: MSS SP-80.
- b. CWP Rating: 200 psig.
- c. Body Design: Vertical flow.
- d. Body Material: ASTM B 61, ASTM B 62, bronze.

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- e. **Ends: Threaded.**
- f. **Disc: Bronze, Type 1.**

2.7 BRONZE SWING CHECK VALVES

- A. Class 150, Bronze Swing Check Valves with Bronze Disc:

- 1. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 300 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.8 IRON SWING CHECK VALVES

- A. Class 125, Iron Swing Check Valves with Metal Seats:

- 1. Description:

- a. Standard: MSS SP-71, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.**
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

2.9 BRONZE GLOBE VALVES

- A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

- 1. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 300 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.**
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Teflon impregnated, asbestos free.
- h. Handwheel: Malleable iron.**

2.10 IRON GLOBE VALVES

- A. Class 125, Iron Globe Valves:

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1. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Stem: Brass alloy, OS &Y.
 - f. Disc: Renewable bronze seat.
 - g. Trim: Bronze.
 - h. Packing and Gasket: Teflon impregnated, asbestos free.
 - i. Handwheel: Cast iron

2.11 LUBRICATED PLUG VALVES

- A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.**
 - c. Pattern: Regular or short.**
 - d. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
 - e. Plug: Cast iron or bronze with sealant groove.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance³ with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

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3.2 VALVE INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above center of pipe.
- F. Install valves in position to allow full stem movement.
- G. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.
 - 4. Install all check valves a minimum of five pipe diameters downstream of pump discharge or elbow to avoid flow turbulence. In extreme cases add flow straighteners as required to correct the turbulence.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. **Shutoff Service: Ball or butterfly** valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. **Throttling Service except Steam: Globe** valves.
 - 4. **Throttling Service, Steam: Globe** valves.
 - 5. Pump-Discharge Check Valves:
 - a. **NPS 2 and Smaller:** Bronze swing check valves with **bronze** disc.
 - b. **NPS 2-1/2 and Larger:** Iron swing check valves with lever and weight or with spring or iron, **metal**-seat check valves.

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6. Drain Service (except Steam): Two-Piece, Full Port Bronze Ball Valves with Bronze Trim. To be installed with NPS $\frac{3}{4}$ hose thread outlet and hose cap with chain.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. **Bronze Valves:** May be provided with solder-joint ends instead of threaded ends.
 3. Ball Valves:
 - a. **Piece: Two**
 - b. **Port: Full.**
 - c. **Material/Trim: Bronze with:**
 - 1) **Bronze** trim.
 4. Bronze Swing Check Valves:
 - a. **Class 150**
 - b. **Bronze** disc.
 6. Bronze Globe Valves:
 - a. **Class 125**
 - b. **Bronze** disc.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

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2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12:
 - a. 200 CWP,
 - b. **Seat: EPDM.**
 - c. **Disc: Ductile-iron.**
3. **Iron Swing Check Valves: Class 125**, metal seats.
4. **Iron Globe Valves: Class 125.**

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SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.

B. Related Sections:

1. **Division 05** for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
4. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to **ASCE/SEI 7**.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

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2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: **Signed and sealed by a qualified professional engineer.** Show fabrication and installation details and include calculations for the following; include Product Data for components:
 1. Trapeze pipe hangers.
 2. Metal framing systems.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of **carbon steel**.

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2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Anvil International.
- b. Cooper B-Line, Inc.; a division of Cooper Industries.
- c. ERICO/Michigan Hanger Co. ; ERISTRUT Div.
- d. FNW/Ferguson Enterprises
- e. GS Metals Corp.
- f. Hilti, Inc.insert manufacturer's name.
- g. Power-Strut Div. Tyco International.
- h. Thomas & Betts Corporation.
- i. Tolco Inc.
- j. Unistrut; an Atkore International company.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with intumed lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of **carbon steel**.
7. Metallic Coating:

- a. Electroplated zinc.**

- B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Anvil International; a subsidiary of Mueller Water Products, Inc.
- b. Empire Industries, Inc.
- c. ERICO International Corporation.
- d. FNW/Ferguson Enterprises
- e. Haydon Corporation.
- f. NIBCO INC.

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- g. PHD Manufacturing, Inc.
 - h. PHS Industries, Inc.
- 2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 - 3. Standard: Comply with MFMA-4.
 - 4. Channels: Continuous slotted steel channel with inturred lips.
 - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of **carbon steel**.
 - 7. Coating:

a. Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carpenter & Paterson, Inc.
 - 2. Clement Support Services.
 - 3. ERICO International Corporation.
 - 4. National Pipe Hanger Corporation.
 - 5. PHS Industries, Inc.
 - 6. Pipe Shields Inc.
 - 7. Piping Technology & Products, Inc.
 - 8. Rilco Manufacturing Co., Inc.
 - 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping:
 - 1. **Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.**
- C. Insulation-Insert Material for Hot Piping:

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1. **Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psi** minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
 - E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
 - F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: **5000-psi**, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- C. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A 36, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

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- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, **NPS 2-1/2** and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- K. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating **above** Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating **below** Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.

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- c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for **trapeze pipe hangers**.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to **1-1/2 inches**.

3.4 PAINTING

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

3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel **pipe hangers and supports** and attachments for general service applications.
- F. Use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30**.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes **NPS 4 to NPS 24**, requiring up to **4 inches** of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes **NPS 3/4 to NPS 36**, requiring clamp flexibility and up to **4 inches** of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes **NPS 1/2 to NPS 24** if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes **NPS 1/2 to NPS 4**, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes **NPS 3/4 to NPS 8**.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.

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10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 8**.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 3**.
 12. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30**.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes **NPS 2-1/2 to NPS 36** if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes **NPS 1 to NPS 30**, from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes **NPS 2-1/2 to NPS 24**, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes **NPS 2 to NPS 42** if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes **NPS 2 to NPS 24** if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes **NPS 2 to NPS 30** if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24**.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 24** if longer ends are required for riser clamps.

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- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): **750 lb.**

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- b. Medium (MSS Type 32): **1500 lb.**
 - c. Heavy (MSS Type 33): **3000 lb.**
- 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 - 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed **1-1/4 inches**.
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to **25 percent** to allow expansion and contraction of piping system from hanger.
 - 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to **25 percent** to allow expansion and contraction of piping system from base support.
 - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to **25 percent** to allow expansion and contraction of piping system from trapeze support.
 - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected

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equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

- a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use **powder-actuated fasteners** instead of building attachments where required in concrete construction.

END OF SECTION 230529

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SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

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 SCOPE

- A. Provide engineered vibration isolation and restraint systems in accordance with the requirements of this section including design, engineering, materials, testing, inspections and reports.
- B. Mechanical equipment with moving parts shall be mounted on or suspended from vibration isolators to reduce the transmission of vibration and mechanically transmitted sound to the building structure.
- C. All mechanical equipment, piping and ductwork shall be restrained as required by Federal, State and Local building codes to preserve the integrity of nonstructural building components during **seismic** events to minimize hazards to occupants and reduce property damage.

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Elastomeric isolation pads.
 - 2. Elastomeric isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Open-spring isolators.
 - 5. Housed-spring isolators.
 - 6. Restrained-spring isolators.
 - 7. Housed-restrained-spring isolators.
 - 8. Pipe-riser resilient supports.
 - 9. Resilient pipe guides.

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10. Air-spring isolators.
11. Restrained-air-spring isolators.
12. Elastomeric hangers.
13. Spring hangers.
14. Snubbers.
15. Restraint channel bracings.
16. Restraint cables.
17. Seismic-restraint accessories.
18. Mechanical anchor bolts.
19. Adhesive anchor bolts.
20. Vibration isolation equipment bases.
21. Restrained isolation roof-curb rails.
22. Certification of **seismic** restraint designs.
23. Installation supervision.
24. Design of attachment of housekeeping pads.
25. All components requiring IBC compliance and certification.
26. All inspection and test procedures for components requiring IBC compliance.
27. Restraint of all mechanical equipment, pipe and ductwork, within, on, or outdoors of the building and entry of services to the building, up to but not including, the utility connection, is part of this Specification.
28. Seismic certification of equipment

1.4 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. ASCE: American Society of Civil Engineers
- D. OSHPD: Office of Statewide Health Planning and Development for the State of California.

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- E. Ip: Importance Factor.
- F. ESSENTIAL FACILITIES, (Occupancy Category IV, IBC-2018)

1. Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.

G. LIFE SAFETY

1. All systems involved with fire protection, including sprinkler piping, jockey pumps, fire pumps, control panels, service water supply piping, water tanks, fire dampers, smoke exhaust systems and fire alarm panels.
2. All mechanical, electrical, plumbing or fire protection systems that support the operation of, or are connected to, emergency power equipment, including all lighting, generators, transfer switches and transformers.
3. All medical and life support systems.
4. Hospital heating systems and air conditioning systems for maintaining normal ambient temperature.
5. Automated supply, exhaust, fresh air and relief air systems on emergency control sequence, including air handlers, duct, dampers, etc., or manually-operated systems used for smoke evacuation, purge or fresh air relief by the fire department.
6. Heating systems in any facility with Occupancy Category IV, IBC-2009 where the ambient temperature can fall below 32 degrees Fahrenheit.

H. HIGH HAZARD

1. All gases or fluids that must be contained in a closed system which are flammable or combustible. Any gas that poses a health hazard if released into the environment and vented Fuel Cells.

1.5 REFERENCE CODES AND STANDARDS

- A. Codes and Standards: The following shall apply and conform to good engineering practices unless otherwise directed by the Federal, State or Local authorities having jurisdiction.

1. IBC
2. ASCE 7
3. NFPA 13 (National Fire Protection Association)
4. IBC 2018 replaces all references to IBC 2006, 2009, 2012.

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- B. The following guides may be used for supplemental information on typical seismic installation practices. Where a conflict exists between the guides and these construction documents, the construction documents will preside.

1. FEMA (Federal Emergency Management Agency) manuals 412, Installing Seismic Restraints for Mechanical Equipment and 414, Installing Seismic Restraints for Ductwork and Pipe.
2. SMACNA (Sheet Metal and Air-conditioning Contractors' National Association) Seismic Restraint Manual Guidelines for Mechanical Systems, 3rd ed.
3. ASHRAE (American Society for Heating, Refrigerating and Air-conditioning Engineers) A Practical Guide to Seismic Restraint
4. MSS (Manufacturers Standardization Society of the Valve and Fittings Industry) MSS SP-127, Bracing for Piping Systems, Seismic – Wind – Dynamic, Design, Selection, Application.

1.6 ISOLATOR AND RESTRAINT MANUFACTURER'S RESPONSIBILITIES:

- A. Provide project specific vibration isolation and seismic restraint design prepared by a registered design professional in the state where the project is being constructed, and manufacturer certifications that the components are seismically qualified.

1. Provide calculations to determine restraint loads resulting from seismic forces as required by IBC, Chapter 16 and ASCE 7, latest editions. Seismic calculations shall be certified by an engineer licensed in the state where the project is being constructed.

- B. Provide installation instructions and shop drawings for all materials supplied under this section of the specifications.

1. Provide seismic restraint details with specific information relating to the materials, type, size, and locations of anchorages; materials used for bracing; attachment requirements of bracing to structure and component; and locations of transverse and longitudinal sway bracing and rod stiffeners.

2. Provide seismic bracing layout drawings indicating the location of all seismic restraints.

- a. Each piece of rotating isolated equipment shall be tagged to clearly identify quantity and size of vibration isolators and seismic restraints.

C. Provide, in writing, the special inspection requirements for all Designated Seismic Systems as indicated in Chapter 17 of the IBC.

D. Provide training for installation, operation and maintenance of isolation and restraint systems.

1.7 PERFORMANCE REQUIREMENTS

A. Flood-Restraint Loading: Per the structural drawings and specifications.

B. Seismic-Restraint Loading:

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1. Site Class as Defined in the IBC: Per the structural drawings and specifications.
2. Assigned Occupancy Category as Defined in the IBC: Per the structural drawings and specifications.
 - a. Component Importance Factor: 1.5.
 - 1) Life safety components required to function after an earthquake.
 - 2) Components containing hazardous or flammable materials in quantities that exceed the exempted amounts for an open system listed in Chapter 4.
 - 3) For structures with an Occupancy Category IV, components needed for continued operation of the facility or whose failure could impair the continued operation of the facility.
 - 4) Storage racks in occupancies open to the general public (e.g., warehouse retail stores).
 - b. Component Importance Factor: 1.0.
 - 1) All other components
 - c. Component Response Modification Factor: Per the structural drawings and specifications.
 - d. Component Amplification Factor: Per the structural drawings and specifications.
3. Design Spectral Response Acceleration at Short Periods: Per the structural drawings and specifications.
4. Design Spectral Response Acceleration at 1-Second Period: Per the structural drawings and specifications.

1.8 ACTION SUBMITTALS

A. Product Data: For the following:

1. Submittals shall include catalog cut sheets and installation instructions for each type of anchor and seismic restraint used on equipment or components being isolated and/or restrained.
2. Submittals for mountings and hangers incorporating springs shall include spring diameter and free height, rated load, rated deflection, and overload capacity for each vibration isolation device.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an **evaluation service member of ICC-ES**.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
4. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

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B. Shop Drawings:

1. 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.

C. Delegated-Design Submittal: For vibration isolation and seismic-restraint details 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. "Basis for Design" report: Statement from the registered design professional that the design complies with the requirements of the ASCE 7-10 Chapter 13, IBC 2018 chapter 1908 and ACI 318. In addition, the basis for compliance must also be noted, as listed below:

- a. Project specific design documentation prepared and submitted by a registered design professional (ASCE 7, 13.2.1.1)
- b. Submittal of the manufacturer's certification that the isolation equipment is seismically qualified by:
- c. An engineered analysis conforming to the requirements of Chapter 13 of ASCE 7.
- d. Testing by a nationally recognized testing standard procedure such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
- e. Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.

2. Seismic restraint load ratings must be certified and substantiated by testing or calculations under direct control of a registered professional engineer. Copies of testing and calculations must be submitted as part of submittal documents. OSHPD pre-approved restraint systems are exempt from this requirement if their pre-approval is current and based upon the IBC 2009 (i.e. OPA-07 pre-approval numbers).

3. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

4. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, **seismic** forces required to select vibration isolators, **seismic** restraints, and for designing vibration isolation bases.

- a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.

5. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

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6. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

7. **Seismic**-Restraint Details:

- a. Design Analysis: To support selection and arrangement of **seismic** restraints. Include calculations of combined tensile and shear loads.
- b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
- c. Preapproval and Evaluation Documentation: By **an evaluation service member of ICC-ES**, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.9 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

1. Submittal drawings and calculations must be stamped by a registered professional engineer in the State where the project is being constructed who is responsible for the seismic restraint design.

2. Calculations and restraint device submittal drawings shall specify anchor bolt type, embedment, concrete compressive strength, minimum spacing between anchors, and minimum distances of anchors from concrete edges. Concrete anchor locations shall not be near edges, stress joints, or an existing fracture. All bolts shall be ASTM A307 or better.

- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control test reports.

1.10 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

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- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

1.11 SEISMIC CERTIFICATION OF EQUIPMENT

- A. Component Importance Factor. All plumbing and mechanical components shall be assigned a component importance factor. The component importance factor, I_p , shall be taken as 1.5 if any of the following conditions apply:
 - 1. The component is required to function for life-safety purposes after an earthquake.
 - 2. The component contains hazardous materials.
 - 3. The component is in or attached to an Occupancy Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.
- B. All other components shall be assigned a component importance factor, I_p , equal to 1.0.
- C. For equipment or components where $I_p = 1.0$.
 - 1. Submit manufacturer's certification that the equipment is seismically qualified by:
 - a. An engineered analysis conforming to the requirements of Chapter 13 of ASCE 7.
 - b. Testing by a nationally recognized testing standard procedure such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
 - c. Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
 - 2. The equipment and components listed below are considered rugged and shall not require Special Seismic Certification:
 - a. Valves (not in cast-iron housings, except for ductile cast iron).
 - b. Pneumatic operators.
 - c. Hydraulic operators.
 - d. Motors and motor operators.
 - e. Horizontal and vertical pumps (including vacuum pumps).
 - f. Air compressors

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- g. Refrigerators and freezers.
- h. Elevator cabs.
- i. Underground tanks.
- j. Equipment and components weighing not more than 20 lbs. supported directly on structures (and not mounted on other equipment or components) with supports and attachments in accordance with Chapter 13, ASCE 7.

3. Rugged equipment and components in this section are for factory assembled discrete equipment and components only and do not apply to site assembled or field assembled equipment or equipment anchorage. The list is based in part on OSHPD Code Application Notice 2-1708A.5.

D. Special Certification requirements for Designated Seismic Systems (i.e. $I_p = 1.5$): Seismic Certificates of Compliance supplied by manufacturers shall be submitted for all components that are part of Designated Seismic Systems. In accordance with the ASCE 7, certification shall be via one of the following methods:

1. For active mechanical and electrical equipment that must remain operable following the design earthquake:

- a. Testing as detailed by part C.1.b above.
- b. Experience data as detailed by part C.1.c above.
- c. Equipment that is considered "rugged" per part C.2 above.

2. Components with hazardous contents shall be certified by the manufacturer as maintaining containment following the design earthquake by:

- a. Testing as detailed by part C.1.b above.
- b. Experience data as detailed by part C.1.c above.
- c. Engineering analysis utilizing dynamic characteristics and forces. Tanks (without vibration isolators) designed by a registered design professional in accordance with ASME Boiler and Pressure Vessel Code, and satisfying the force and displacement requirements of Sections 13.3.1 and 13.3.2 of ASCE 7 having an importance factor, $I_p = 1.0$ shall be considered to satisfy the Special Seismic Certification requirements on the basis of ASCE 7 Section 13.6.9.

1.12 OWNER SPECIFICATION COMPLIANCE

A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

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PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. CalDyn (California Dynamics Corporation).
3. ISAT (International Seismic Application Technology).
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibro-Acoustics
7. VMC (Vibration Mountings & Controls, Inc.)

B. Elastomeric Isolation Pads **P1**:

1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties.
4. Surface Pattern: **Ribbed** pattern.
5. Load-bearing metal plates adhered to pads.

C. Double-Deflection, Elastomeric Isolation Mounts **M1**:

1. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded, or with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

D. Restrained Elastomeric Isolation Mounts **M2**:

1. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

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- a. Housing: Cast-ductile iron or welded steel.
- b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

E. Spring Isolators **S1**: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

F. Restrained Spring Isolators **S2**: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation. Baseplates shall limit floor load to 500 psig.
2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

G. Housed Restrained Spring Isolators **S3**: Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with **adjustable** snubbers to limit vertical movement.

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- a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric pad: For high frequency absorption at the base of the spring.

H. Elastomeric Hangers **H1**:

1. Description: Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods
 - a. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 - b. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.
- I. Spring Hangers **H2**: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Description: Combination Coil-Spring and Elastomeric-Insert Hanger with spring and Insert in Compression.
 - a. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - g. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

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- J. Spring Hangers with Vertical-Limit Stop **H3**: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Description: Combination Coil-Spring and Elastomeric-Insert Hanger with spring and insert in Compression and vertical limit stop.

- a. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
- b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- f. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
- g. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
- h. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

- K. Pipe Riser Resilient Support **R1**:

1. Description: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick neoprene.

- a. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
- b. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

- L. Resilient Pipe Guides **R2**:

1. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.

- a. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

- M. Horizontal Thrust Restraints **T1**: Modified specification S2 isolator.

1. Horizontal thrust restraints shall consist of a modified specification S2 spring mounting. Restraint springs shall have the same deflection as the isolator springs.

2. The assembly shall be preset at the factory and fine tuned in the field to allow for a maximum of 1/4" movement from stop to maximum thrust.

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3. The assemblies shall be furnished with rod and angle brackets for attachment to both the equipment and duct work or the equipment and the structure.
4. Restraints shall be attached at the center line of thrust and symmetrically on both sides of the unit.

2.2 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amber/Booth Company, Inc.
 2. CalDyn (California Dynamics Corporation).
 3. ISAT (International Seismic Application Technology).
 4. Kinetics Noise Control.
 5. Mason Industries.
 6. Vibro-Acoustics
 7. VMC (Vibration Mountings & Controls, Inc.)
- B. Restrained Vibration Isolation Roof-Curb Rails: **RC1**:
- C. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.
- D. Upper Frame: The upper frame shall provide continuous support for equipment and shall be captive to resiliently resist **seismic** forces.
- E. Lower Support Assembly: The lower support assembly shall be a formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
- F. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch-thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
 1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic and wind restraint.
 - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

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- c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- G. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch-thick.
- H. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.
- I. All roof curbs shall be at least 8-inches (MIN) above the roof membrane.

2.3 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Amber/Booth Company, Inc.
 - 2. CalDyn (California Dynamics Corporation).
 - 3. ISAT (International Seismic Application Technology).
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
 - 6. Vibro-Acoustics
 - 7. VMC (Vibration Mountings & Controls, Inc.)
- B. Steel Bases and Rails **SB1**: Factory-fabricated, welded, structural-steel bases and rails.
- 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Inertia Base **IB1**: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

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1. Design Requirements: Lowest possible mounting height with not less than **[1-inch] 2-inch** clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.4 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. CalDyn (California Dynamics Corporation).
3. ISAT (International Seismic Application Technology).
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibro-Acoustics
7. VMC (Vibration Mountings & Controls, Inc.)

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by **an evaluation service member of ICC-ES**.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.

2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

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- D. Channel Support System: MFMA-4, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- E. Restraint Cables: ASTM A 603 galvanized or ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement. Cables located in exterior or other wet locations such as wash-down areas shall be stainless steel.
- F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.
- G. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- H. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- K. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- L. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.
- M. All post installed anchors utilized in the seismic design must be qualified for use in cracked concrete and approved for use with seismic loads.
- N. Expansion anchors shall not be used for anchorage of equipment with motors rated over 10 HP with the exception of undercut expansion anchors. Spring or internally isolated equipment are exempt from this requirement.
- O. All beam clamps utilized for vertical support must also incorporate retention straps.
- P. All seismic brace arm anchorages to include concrete anchors, beam clamps, truss connections, etc., must be approved for use with seismic loads.

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2.5 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. Baked enamel or powder coat for metal components on isolators for interior use.
 4. Color-code or otherwise mark vibration isolation and **seismic** control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and **seismic** control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 COORDINATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in **Divison 03 Section "Cast-in-Place Concrete."**
- B. Coordinate size, shape, reinforcement and attachment of all housekeeping pads supporting vibration/seismically rated equipment. Concrete shall have a minimum compressive strength of 4,000 psi or as specified by the project engineer. Coordinate size, thickness, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation and seismic restraint device manufacturer to ensure adequate space, embedment and prevent edge breakout failures. Pads and piers must be adequately doweled in to structural slab.
- C. Housekeeping pads shall have adequate space to mount equipment and seismic restraint devices.
- D. Housekeeping Pads must be adequately reinforced and adequately sized for proper installation of equipment anchors and shall also be large enough and thick enough to ensure adequate edge distance and embedment depth for restraint anchor bolts to avoid housekeeping pad breakout failure. Refer seismic restraint manufacturer's written instructions.

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- E. Coordinate with vibration/seismic restraint manufacturer and the structural engineer of record to locate and size structural supports underneath vibration/seismically restrained equipment (e.g. roof curbs, cooling towers and other similar equipment). Installation of all seismic restraint materials specified in this section shall be accomplished as per the manufacturer's written instructions. Adjust isolators and restraints after piping systems have been filled and equipment is at its operating weight, following the manufacturer's written instructions.

3.3 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by **an evaluation service member of ICC-ES** and per the seismic restraint manufacturer's design.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.4 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Comply with requirements in Division 23 Section "Hydronic Piping" for piping flexible connections.
- C. Isolate all mechanical equipment 0.75 hp and over per the isolator and seismic restraint schedule and these specifications. Vibration isolators shall be selected in accordance with the equipment, pipe or duct weight distribution so as to produce reasonably uniform deflections
- D. All isolation materials and seismic restraints shall be of the same vendor and shall be selected and certified using published or factory certified data
- E. Installation of all vibration isolation materials, flexible connectors and supplemental equipment bases specified in this section shall be accomplished as per the manufacturer's written instructions with mountings adjusted to level equipment. Any variance or non-compliance with the manufacturer's instructions shall be reviewed and approved in writing by the manufacturer or corrected by the contractor in an approved manner.
- F. Installation of vibration isolators must not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.
- G. Locate isolation hangers as near to the overhead support structure as possible.

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- H. No rigid connections between isolated components and the building structure shall be made that degrades the noise and vibration control system herein specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls. "Components" includes, but is not limited to, mechanical equipment, piping and ducts.
- I. Coordinate work with other trades to avoid rigid contact with the building.
- J. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- K. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.
- L. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractor's expense.
- M. Use horizontal thrust restraints **T1** to protect Air handling equipment and centrifugal fans against excessive displacement which results from high air thrust when thrust forces exceed 10% of the equipment weight.
- N. Isolated equipment, duct and piping located on roofs must be attached to the structure. Supports (e.g., sleepers) that are not attached to the structure will not be acceptable.
- O. On completion of installation of all isolation materials and before startup of isolated equipment all debris shall be cleared from areas surrounding and from beneath all isolated equipment, leaving equipment free to move on the isolation supports.
- P. All floor mounted isolated equipment shall be protected with specification M1, M2, S1, S2 or S3 isolator.
- Q. Horizontal Pipe Isolation: All HVAC pumped water, pumped condensate, glycol, and refrigerant piping size 1-1/4" and larger within mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50' or 100 pipe diameters from rotating equipment. For the first three (3) support locations from externally isolated equipment provide specification H2 or H3 hangers or specification S1, S2 or S3 mounts with the same deflection as equipment isolators (max 2"). All other piping within the equipment rooms shall be isolated with the same specification isolators with a 3/4" minimum deflection. Steam piping size 1-1/4" and larger which is within an equipment room and connected to rotating equipment shall be isolated for three (3) support locations from the equipment. Provide specification H2 or H3 hangers, or specification S1 or S2 mounts with the same deflection as equipment isolators but a minimum of 3/4".
- R. Install full line size flexible pipe connectors at the inlet and outlet of each pump, cooling tower, condenser, chiller, coiling connections and where shown on the drawings. All connectors shall be suitable for use at the temperature, pressure, and service encountered at the point of installation and operation. End fitting connectors shall

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conform to the pipefitting schedule. Control rods or protective braid must be used to limit elongation to 3/8". Flexible connectors shall not be required for suspended in-line pumps.

- S. All plumbing pumped water, piping size 1-1/4" and larger within mechanical rooms shall be isolated the same as HVAC piping above. Isolators are not required for any plumbing pumped water, pumped condensate, and steam piping outside of mechanical rooms unless listed in the isolation schedule.
- T. Pipe Riser Isolation: The operating weight of all variable temperature vertical pipe risers 1-1/4" and larger, requiring isolation where specifically shown and detailed on riser drawings shall be fully supported by specification M1, M2 or R1 supports. S1, S2, S3, H2 or H3 steel spring deflection isolators with minimum 3/4-inch minimum shall be in those locations where added deflection is required due to pipe expansion and contraction. Spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Height saving brackets used with isolators having 2.5" deflection or greater shall be of the precompression type to limit exposed bolt length. Specification R1 riser supports shall be installed near the center point of the riser to anchor the riser when spring isolation is used. Specification R2 riser guides may be used in conjunction with spring isolators per design calculations. Pipe risers up through 16" shall be supported at intervals of every third floor of the building. Pipe risers 18" and over, every second floor. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Horizontal take-offs and at upper and lower elbows shall be supported with spring isolators as required to accommodate anticipated movement. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist if installed per design proposed.
- U. Where riser pipes pass through cored holes, core diameters shall be a maximum of 2" larger than pipe O.D. including insulation. Cored holes must be packed with resilient material or firestop as provided by other sections of this specification or local codes. Where seismic restraint is required specification isolator S3 shall support risers and provide longitudinal restraint at floors where thermal expansion is minimal and will not bind isolator restraints.
- V. Duct Isolation: Isolate all duct work with a static pressure 2" W.C. and over in equipment rooms and to minimum of 50 feet from the fan or air handler. Use specification type H2 or H3 hangers or type S1 or S2 floor mounts.

3.5 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. On projects with Seismic Site Class A or B, seismic design or restraint is not required.

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2. On projects with Seismic Design Category C: Components with an importance factor of 1.0 do not require seismic design or restraint.

3. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

4. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

5. Install seismic-restraint devices using methods approved by **an evaluation service member of ICC-ES** providing required submittals for component.

6. Suspended Equipment: All suspended equipment that meets any of the following conditions requires seismic restraints as specified by the supplier:

- a. Rigidly attached to pipe or duct that is 75 lbs. and greater,
- b. Items greater than 20 lbs and distribution systems weighing more than 5 lbs/lineal foot, with an importance factor of 1.0 hung independently or with flexible connections.
- c. Possibility of consequential damage.
- d. For importance factors greater than 1.0 all suspended equipment requires seismic restraint regardless of the above notes.
- e. Wall mounted equipment weighing more than 20 lbs.
- f. Exemptions:
 - 1) Equipment weighing less than 20 lbs and distribution systems weighing less than 5 lbs/lineal foot, with an $I_p = 1.0$ and where flexible connections exist between the component and associated ductwork, piping or conduit.

7. Base Mounted Equipment: All base mounted equipment that meets any of the following conditions requires attachments and seismic restraints as specified by the supplier:

- a. Connections to or containing hazardous material,
- b. With an overturning moment.
- c. Weight greater than 400 lbs.
- d. Mounted on a stand 4 ft. or more from the floor
- e. Possibility of consequential damage.
- f. For importance factors greater than 1.0 all base mounted items require seismic restraints regardless of the above notes.
- g. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.
- h. Exemptions:
 - 1) Floor or curb-mounted equipment weighing less than 400 lbs and not resiliently mounted, where the Importance Factor, $I_p = 1.0$, the components are mounted at 4 feet or less above a floor level, flexible connections between the components and associated duct work, piping and conduit are provided and there is no possibility of consequential damage.

8. Roof Mounted Equipment:

- a. To be installed on a structural frame, seismically rated roof curb, or structural curb frame mechanically connected to the structure. Items shall not be mounted onto sleepers or pads that are not mechanically and rigidly attached to the structure. Restraint must be adequate to resist both seismic and wind forces.
- b. Roof curbs shall be installed directly to building structural steel or concrete roof deck and not to top of steel deck or roofing material.
- c. Exemptions:
 - 1) Curb-mounted mushroom, exhaust and vent fans with curb area less than nine square feet are excluded.

9. Rigid Mounted Equipment:

- a. Anchor floor and wall mounted equipment to the structure as per the stamped seismic certifications / drawings.
- b. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.
- c. Suspended equipment shall be restrained using seismic cable restraints, or struts, and hanger rods as per the stamped seismic certifications / drawings.

10. Vibration Isolated Equipment:

- a. Seismic control shall not compromise the performance of noise control, vibration isolation or fire stopping systems.
 - b. Equipment supported by vibration-isolation hangers shall be detailed and installed with approximately a 1/8" gap between the isolation hangers and the structure. Isolators at restraint locations must be fitted with uplift limit stops.
- B. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
- C. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
- D. Install seismic-restraint devices using methods approved by **an evaluation service member of ICC-ES** providing required submittals for component.
- E. Installation and adjustment of all seismic restraints specified in this section shall be accomplished as per the manufacturer's written instructions. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.
- F. Piping Restraints:
- 1. Comply with requirements in ASCE 7-10 Chapter 13.
 - 2. Branch lines may not be used to brace main lines.

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3. All piping requires restraint unless it meets any of the exemptions listed below.

4. Exemptions:

- a. All high deformability pipe 3" or less in diameter suspended by individual hanger rods where $l_p = 1.0$.
 - b. High deformability pipe or conduit in Seismic Design Category C, 2" or less in diameter suspended by individual hanger rods where $l_p = 1.5$.
 - c. High deformability pipe in Seismic Design Category D, E or F, 1" or less in diameter suspended by individual hanger rods where $l_p = 1.5$.
 - d. All clevis supported pipe runs installed less than 12" from the top of the pipe to the underside of the support point and trapeze supported pipe suspended by hanger rods having a distance less than 12" in length from the underside of the pipe support to the support point of the structure.
 - e. Piping systems, including their supports, designed and constructed in accordance with ASME B31.
 - f. Piping systems, including their supports, designed and constructed in accordance with NFPA, provided they meet the force and displacement requirements of Section 13.3.1 and 13.3.2 (ASCE 7).
- G. Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement.
- H. Install flexible piping connectors where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.
- I. Where pipe sizes reduce below dimensions required for seismic, the final restraint shall be installed at the transition location.
- J. Restraint Spacing For Piping: Sizes shown are maximum. Actual spacing determined by calculation.
1. For non-ductile piping (e.g., cast iron, PVC) space transverse supports a maximum of 20' o.c., and longitudinal supports a maximum of 40' o.c.
 2. For piping with hazardous material inside (e.g., natural gas, medical gas) space Transverse supports a maximum of 20' o.c., and longitudinal supports a maximum of 40' o.c.
 3. For pipe risers, restrain the piping at floor penetrations using the same spacing requirements as above.
 4. For all other ductile piping see Table "A" below
- K. Seismic Restraint of Ductwork: Seismically restrain per specific code requirements, all ductwork listed below (unless otherwise indicated on the drawings), using seismic cable restraints: (Ductwork not meeting criteria listed below is to be "Exempt")
1. Restrain rectangular ductwork with cross sectional area of 6 square feet or larger. Duct with and an importance factor of 1.5 must be braced with no exceptions regardless of size or distance requirements.

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2. Restrain round ducts with diameters of 33" or larger. Duct with an importance factor of 1.5 must be braced with no exceptions regardless of size or distance requirements.
3. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
4. Duct must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze. Additional reinforcing is not required if duct sections are mechanically fastened together with frame bolts and positively fastened to the duct support suspension system.
5. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
6. Walls, including gypsum board non-bearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
7. If ducts are supported by angles, channels or struts, ducts shall be fastened to it at seismic brace locations in lieu of duct reinforcement.
8. All ductwork weighing more than 17 lb/ft.
9. Exemptions:
 - a. Duct runs supported at locations by two rods less than 12 inches in length from the structural support to the structural connection to the ductwork. This exemption does not apply to ducts with an importance factor of 1.5.

10. See Table "A" below for restraint spacing.

L. Exemptions do not apply for:

1. Life Safety or High Hazard Components

- a. Including gas, fire protection, medical gas, fuel oil and compressed air needed for the continued operation of the facility or whose failure could impair the facility's continued operation, Occupancy Category IV, IBC-2009 as listed in Section 1.3 B regardless of governing code for HVAC, Plumbing, Electrical piping or equipment. (A partial list is illustrated.) High Hazard is additionally classified as any system handling flammable, combustible or toxic material. Typical systems not excluded are additionally listed below.

2. Piping

- a. Fuel oil, gasoline, natural gas, medical gas, steam, compressed air or any piping containing hazardous, flammable, combustible, toxic or corrosive materials. Fire protection standpipe, risers and mains. Fire Sprinkler Branch Lines must be end tied.

3. Duct

- a. Smoke evacuation duct or fresh air make up connected to emergency system, emergency generator exhaust, boiler breeching or as used by the fire department on manual override.

4. Equipment

- a. Previously excluded non life safety duct mounted systems such as fans, variable air volume boxes, heat exchangers and humidifiers having a weight greater than 75 lbs require independent seismic bracing.

M. Spacing Chart For Suspended Components:

Table "A" Seismic Bracing			
(Maximum Allowable Spacing Shown- Actual Spacing to Be Determined by Calculation)			
Equipment	On Center Transverse	On Center Longitudinal	Change Of Direction
Duct			
All Sizes	30 Feet	60 Feet	4 Feet
Pipe Threaded, Welded, Soldered Or Grooved			
To 16"	40 Feet	80 Feet	4 Feet
18" – 28"	30 Feet	60 Feet	4 Feet
30" – 40"	20 Feet	60 Feet	4 Feet
42" & Larger	10 Feet	30 Feet	4 Feet

- N. Roof mounted duct is to be installed on sleepers or frames mechanically connected to the building structure. Roof anchors and seismic cables or frames shall be used to resist seismic and wind loading. Wind loading factors shall be determined by the registered design professional.
- O. Where duct sizes reduce below dimensions required for seismic restraint the final restraint shall be installed at the transition location.
- P. Install cables so they do not bend across edges of adjacent equipment or building structure.
- Q. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

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- R. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- S. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- T. Seismically Rated Beam Clamps are required where welding to or penetrations to steel beams are not approved.
- U. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.6 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 23 Section "Hydronic Piping" for piping flexible connections.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.

1. A representative of the vibration isolation system manufacturer shall review the project installation and provide documentation indicating conformance to vibration isolation design intent

- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

1. The installing contractor shall submit a report upon request to the building architect and/or engineer, including the manufacturer's representative's final report, indicating that all seismic restraint material has been properly installed, or steps that are to be taken by the contractor to properly complete the seismic restraint work as per the specifications.

3.8 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

1. Adjust active height of spring isolators.

- C. 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.

- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

EQUIPMENT ISOLATION SCHEDULE									
LOCATION	A' CRITICAL (35'-50' SPAN)			B' UPPER STORY (20'-35' SPAN)			C' GRADE		
	ISOLATOR	MINIMUM	BASE	ISOLATOR	MINIMUM	BASE	ISOLATOR	MINIMUM	BASE
	TYPE	DEFLECTION (IN)	TYPE	TYPE	DEFLECTION (IN)	TYPE	TYPE	DEFLECTION (IN)	TYPE
EQUIPMENT (1)									
AIR HANDLING UNITS									

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FLOOR MOUNTED									
UP TO 15 HP	S3	1.5		S3	0.75		S3	0.75	
20 HP & OVER	S3	2.5	SB1	S3	1.5		S3	0.75	
SUSPENDED									
UP TO 15 HP	H3	1.75		H3	1		H3	1	
20 HP & OVER	H3	2.5	SB1	H3	1.75		H3	1	
HIGH PRESSURE FAN SECTIONS									
UP TO 30 HP	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	IB1
40 HP & OVER	S1	3.5	IB1	S3	2.5	IB1	S3	1.5	IB1
CENTRIFUGAL FANS									
CL. I & II UP TO 54-112" W.D.									
UPT015HP	S3	1.5	SB1	S3	0.75	SB1	S3	0.75	SB1
20-50 HP	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	SB1
60 HP & OVER	S1	3.5	IB1	S1	2.5	IB1	S3	1.5	SB1
CL. I & II 60" W.D. & OVER I ALL CL. III FANS									
UPT015HP	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	IB1
20-50 H P	S1	2.5	IB1	S1	2.5	IB1	S3	1.5	IB1
60 HP & OVER	S1	3.5	IB1	S1	2.5	IB1	S3	1.5	IB1
AXIAL FLOWFANS									
FLOOR MTD.									
UP TO 15 HP	S3	1.5	SB1	S3	0.75		S3	0.75	
20 HP & OVER	S1	3.5	IB1	S3	1.5		S3	0.75	
SUSPENDED									
UP TO 15 HP	H3	1.75	SB1	H3	1		H3	1	
20 HP & OVER	H3	2.5	SB1	H3	1.75	SB1	H3	1.5	

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VENT (UTILITY SETS)									
FLOOR MTD	S3	1.5	SB1	S3	0.75		S3	0.75	
SUSPENDED	H3	1.75	SB1	H3	1		H3	0.75	
CABINET FANS, FANS SECTIONS									
FLOOR MTD.									
UP TO 15 HP	S3	1.5		S3	0.75		S3	0.75	
20 HP & OVER	S1	2.5	IB1	S3	1.5		S3	0.75	
SUSPENDED									
UP TO 15 HP	H3	1.75		H3	1		H3	0.75	
20 HP & OVER	H3	2.5	SB1	H3	1.75		H3	1.75	
PUMPS									
FLOOR MTD.									
UP TO 15 HP	S3	0.75	IB1	S3	0.75	IB1	SRVD	0.4	IB1
7-112 HP & OVER	S3	1.5	IB1	S3	1.5	IB1	S3	0.75	IB1
SUSPENDED INLINE	H3	1.75		H3	1.75		H3	1	
REFRIGERATION UNITS									
RECIPROCATING COMPRESSORS	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	IB1
RECIPROCATING COND. UNITS & CHILLERS	S1	2.5	IB1	S3	1.5		S3	0.75	
HERMETIC CENTRIFUGALS	S3	2.5		S3	1.5		P1	0.15	
OPEN CENTRIFUGALS	S1	2.5	IB1	S3	1.5	IB1	P1	0.15	
ABSORPTION MACHINES	S3	1.5		S3	0.75		P1	0.15	
AIR COMPRESSORS									
TANK TYPE (HORIZONTAL TANK)	S1	2.5	IB1	S3	1.5		S3	0.75	
TANK TYPE (VERTICAL	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	

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TANK)									
COOLING TOWERS & CLOSED CIRCUIT COOLERS									
UP TO 500 TONS	S3	2.5		S3	0.75		P1	0.15	
OVER 500 TONS	S3	4.5		S3	2.5		P1	0.15	
AIR COOLED CONDENSERS									
UP TO 50 TONS	S3	1.5		S3	0.75		P1	0.15	
OVER 50 TONS	S3	2.5		S3	1.5		P1	0.15	
ROOFTOP AIR CONDITIONING UNITS									
REQUIRING WEATHER SEAL									
UP TO 5000 CFM (12 TON)	S1	1.5	RC1	S1	0.75	RC1			
OVER 5000 CFM (12 TON)	S3	2.5	RC1	S3	1.5	RC1			
OTHER TYPES									
UP TO 25 TONS	S3	1.5		S3	1.5				
OVER 25 TONS	S3	2.5		S3	1.5				
BOILER (PACKAGE TYPE)									
ALL SIZES	S3	1.5		S3	0.75		P1	0.15	
ENGINE DRIVEN GENERATORS									
UP TO 60 HP	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	
75 HP & OVER	S1	3.5	IB1	S3	2.5	IB1	S3	0.75	

NOTES:

1) Thrust restraints required on all high-pressure fan section, suspended axial-flow fans and on floor-mounted axial fans operating at 3.0" S.P. or greater.

END OF SECTION 230548

SECTION 230550 - OPERATION AND MAINTENANCE OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All pertinent sections of Division 21, 22, & 23 Mechanical General Requirements, are part of the work of this Section. Division 1 is part of this and all other sections of these specifications.
 - 1. Testing and Balancing is specified in section 230594.
 - 2. Training and Instructions to Owner's Representative is specified in section 230100.

1.2 SCOPE OF WORK

- A. Submission of Operating and Maintenance Manuals complete with Balancing reports. (Coordinate with Division 1).
- B. Coordination of work required for system commissioning.
- C. **Provide a hard copy and an electronic copy on CD of the O and M manual fully searchable in PDF format.**

1.3 SUBMITTALS

- A. Submit product data in accordance with Division 1 and Section 230100. Submit the following:
 - 1. Sample of O and M manual outline.
 - 2. Hard copy and an electronic copy on CD of the O and M manual fully searchable in PDF format. Both the hard copy and the electronic copy are to be fully indexed. The electronic copy shall also have a linked index.

1.4 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 O & M MANUALS

A. The operating and maintenance manuals shall be as follows:

1. Binders shall be red buckram with easy-view metal for size 8-1/2 x 11-inch sheets, with capacity expandable from 2 inches to 3-1/2 inches as required for the project. Construction shall be rivet-through with library corners. No. 12 backbone and lining shall be the same material as the cover. The front cover and backbone shall be foil-stamped in white as follows: (coordinate with **Division 01**)

OPERATING AND MAINTENANCE
MANUAL
FOR THE

(INSERT PROJECT NAME)

(INSERT PROJECT COMPLETION YEAR)

VOLUME No. ()

VAN BOERUM & FRANK ASSOCIATES, INC.
MECHANICAL ENGINEER

(INSERT ARCHITECT)

PART 3 - EXECUTION

3.1 OPERATING AND MAINTENANCE MANUALS:

- A. Work under this section shall be performed in concert with the contractor performing the system testing and balancing. Six (6) copies of the manuals shall be furnished to the Architect for distribution to the owner.

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- B. The "Start-Up and Operation" section is one of the most important in the manual. Information in this section shall be complete and accurately written and shall be verified with the actual equipment on the job, such as switches, starters, relays, automatic controls, etc. A step-by-step start-up procedure shall be described.
- C. The manuals shall include air and water-balancing reports, system commissioning procedures, start-up tests and reports, equipment and system performance test reports, warranties, and certificates of training given to the owner's representatives. An index sheet typed on AICO Gold-Line indexes shall be provided in the front of the binder. The manual shall include the following:

SYSTEM DESCRIPTIONS

START-UP PROCEDURE AND OPERATION OF SYSTEM

MAINTENANCE AND LUBRICATION TABLE

OPERATION AND MAINTENANCE BULLETINS

AUTOMATIC TEMPERATURE CONTROL DESCRIPTION OF OPERATION, INTERLOCK AND CONTROL DIAGRAMS, AND CONTROL PANELS.

AIR AND WATER SYSTEM BALANCING REPORTS

EQUIPMENT WARRANTIES AND TRAINING CERTIFICATES

SYSTEM COMMISSIONING REPORTS

EQUIPMENT START-UP CERTIFICATES

END OF SECTION 230550

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Danger, Warning and Caution signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Stencils.
 - 6. Valve tags.
 - 7. Danger tags.
 - 8. Warning tags.
 - 9. Caution tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.5 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

- 1. Material and Minimum Thickness, predrilled or stamped holes for attachment hardware:

a. Brass, 0.032-inch .

- 2. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2** by **3/4 inch**.
- 3. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less **than 24 inches**, **1/2 inch** for viewing distances up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- 4. Fasteners: Stainless-steel;

a. Rivets or self-tapping screws

- 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

- 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, and having predrilled holes for attachment hardware, **1/16 inch** thick.
- 2. Letter Color:

a. Black.

3. Background Color:
 - a. **White.**
4. Maximum Temperature: Able to withstand temperatures up to **160 deg F.**
5. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch.**
6. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel;
 - a. **Rivets or self-tapping screws**
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 DANGER, WARNING AND CAUTION SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, having predrilled holes for attachment hardware; **1/16 inch** thick.
- B. Danger signs, colors:
 1. Letter Color:
 - a. **White.**
 2. Background Color:
 - a. **Red.**
- C. Warning signs, colors:
 1. Letter Color:

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- a. **Black.**
 2. Background Color:
 - a. **Orange.**
 - D. Caution signs, colors:
 1. Letter Color:
 - a. **Black.**
 2. Background Color:
 - a. **Yellow.**
 - E. Maximum Temperature: Able to withstand temperatures up to **160 deg F.**
 - F. Minimum Label Size: Length and width vary for required label content, but not less **than 2-1/2 by 3/4 inch.**
 - G. 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.
 - H. Fasteners: Stainless-steel;
 1. Rivets or self-tapping screws
 2. Rivets.
 - I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
 - J. Label Content: Include caution and warning information, plus emergency notification instructions.
- 2.3 PIPE LABELS
 - A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
 - B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to **partially cover** circumference of pipe and to attach to pipe without fasteners or adhesive.
 - C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
 - D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

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1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, having predrilled holes for attachment hardware; **1/16 inch** thick.
- B. Letter Color:
 1. **White.**
- C. Background Color:
 1. **Black.**
- D. Maximum Temperature: Able to withstand temperatures up to **160 deg F.**
- E. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch.**
- F. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel;
 1. Rivets or self-tapping screws
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 2. Lettering Size: At least **1-1/2 inches** high.

2.5 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of **1-1/4 inches** for ducts; and minimum letter height of **3/4 inch** for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material:
 - a. **Aluminum .**
2. Stencil Paint:
 - a. Exterior, gloss, **alkyd enamel** black unless otherwise indicated.
 - b. Paint may be in pressurized spray-can form.
3. Identification Paint:
 - a. Exterior, **alkyd enamel** in colors according to ASME A13.1 unless otherwise indicated.

2.6 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 1. Tag Material, predrilled or stamped holes for attachment hardware, minimum thickness:
 - a. **Brass, 0.032-inch**
 2. Fasteners: Brass;
 - a. **Wire-link or beaded chain; or S-hook**
- B. Valve Schedules:
 1. For each piping system, on **8-1/2-by-11-inch** bond paper, tabulate;
 - a. Valve number.
 - b. Piping system.
 - c. System abbreviation (as shown on valve tag).
 - d. Location of valve (room or space).
 - e. Normal-operating position (open, closed, or modulating).
 - f. Variations for identification.
 - g. Mark valves for emergency shutoff and similar special uses.
 2. Valve-tag schedule:
 - a. Shall be included in operation and maintenance data.

2.7 DANGER TAGS

- A. Danger Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size:
 - a. **3 by 5-1/4 inches minimum**
 - 2. Fasteners:
 - a. **Brass grommet and wire.**
 - 3. Nomenclature: Large-size primary caption such as "DANGER," and "DO NOT OPERATE."
 - 4. Color: Red background with white lettering.

2.8 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size:
 - a. **3 by 5-1/4 inches minimum**
 - 2. Fasteners:
 - a. **Brass grommet and wire.**
 - 3. Nomenclature: Large-size primary caption such as "WARNING" and "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

2.9 CAUTION TAGS

- A. Caution Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size:
 - a. **3 by 5-1/4 inches minimum**
 - 2. Fasteners:
 - a. **Brass grommet and wire.**

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3. Nomenclature: Large-size primary caption such as "CAUTION," and "DO NOT OPERATE."
4. Color: Orange background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in **Division 09**.
- B. Stenciled Pipe Label Option:
 1. Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option.
 2. Install stenciled pipe labels **with painted, color-coded bands or rectangles** on each piping system.
 3. Install stenciled pipe labels, **complying with ASME A13.1**, on each piping system.
 - a. Identification Paint: Use for contrasting background.
 - b. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

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4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of **50 feet** along each run. Reduce intervals to **25 feet** in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
8. Where piping is installed in open ceiling, locate pipe label on the top side of the pipe, out of view from the floor.

D. Pipe Label Color Schedule: (See Drawing Schedules)

3.4 DUCT LABEL INSTALLATION

- A. Install **plastic-laminated** duct labels with permanent adhesive on air ducts in the following color codes:
 1. **Red** : For supply ducts.
 2. **Blue** : For return ducts.
 3. **Green** : For exhaust-, outside-, relief-, and mixed-air ducts.
 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of **50 feet** in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION (See Drawing Schedules.)

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

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. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - 3. Various HVAC Equipment.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within the following number of days of the Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article;
 - 1. **30 days.**
- B. Certified TAB reports.

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C. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by **AABC** or **NEBB**.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by **AABC** or **NEBB** and shall be the same as the TAB Contractor.
2. TAB Technician: Employee of the TAB contractor and who is certified by **AABC** or **NEBB** as a TAB technician and shall be the same as the TAB Contractor.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by:

1. **Architect.**

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Notice: Provide [**seven**] days' advance notice for each test. Include scheduled test dates and times.

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- B. Perform TAB after leakage and pressure tests on the following distribution systems have been satisfactorily completed:
 - 1. **Air .**
 - 2. **Water .**
 - 3. **Air and water .**

1.8 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

- A. Subject to compliance with requirements, **engage one of the following:**
 - 1. Bonneville Test and Balance
 - 2. BTC Service.
 - 3. Certified Test & Balance.
 - 4. Diamond Test & Balance.
 - 5. RS Analysis.
 - 6. Test & Balance Inc.
 - 7. Payson Sheetmetal.
 - 8. QT&B Inc.

3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

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- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine:
 - 1. Ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in:
 - a. **Section 233113 "Metal Ducts"**
 - 2. Verify ceiling plenums and underfloor air plenums used for supply, return or relief air are properly separated from adjacent areas.
 - 3. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

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- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in this section and:
 - 1. AABC's "National Standards for Total System Balance"**
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713

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"Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in **inch-pound (IP)** .

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

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2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from one of the following entities for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance:
 - a. **Architect .**
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.

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3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

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- a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
 6. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.

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4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check liquid level in expansion tank.
 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.9 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

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1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from the following entity and comply with requirements in Section 232123 "Hydronic Pumps." :
 - 1) **[Architect]** .
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.

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3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.11 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 1. Entering- and leaving-water temperature.
 2. Water flow rate.
 3. Water pressure drop.
 4. Dry-bulb temperature of entering and leaving air.
 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 6. Airflow.
 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
 1. Nameplate data.
 2. Airflow.
 3. Entering- and leaving-air temperature at full load.
 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 5. Calculated kilowatt at full load.
 6. Fuse or circuit-breaker rating for overload protection.

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- C. Measure, adjust, and record the following data for each steam coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Airflow.
 - 3. Air pressure drop.
 - 4. Inlet steam pressure.

- D. Measure, adjust, and record the following data for each refrigerant coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.
 - 4. Air pressure drop.
 - 5. Refrigerant suction pressure and temperature.

3.12 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: **Plus or minus 10 percent** .
 - 2. Air Outlets and Inlets: **Plus or minus 10 percent** .
 - 3. Heating-Water Flow Rate: **Plus or minus 10 percent** .
 - 4. Cooling-Water Flow Rate: **Plus or minus 10 percent** .

3.13 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare progress reports on the following interval to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors;

1. Weekly.

3.14 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.

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- b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
- 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
- 1. Quantities of outdoor, supply, return, and exhaust airflows.
 - 2. Water and steam flow rates.
 - 3. Duct, outlet, and inlet sizes.
 - 4. Pipe and valve sizes and locations.
 - 5. Terminal units.
 - 6. Balancing stations.
 - 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
- 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.

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- i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- j. Number, make, and size of belts.
- k. Number, type, and size of filters.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Filter static-pressure differential in inches wg.
- f. Preheat-coil static-pressure differential in inches wg.
- g. Cooling-coil static-pressure differential in inches wg.
- h. Heating-coil static-pressure differential in inches wg.
- i. Outdoor airflow in cfm.
- j. Return airflow in cfm.
- k. Outdoor-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft..
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.

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- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
 - e. Return-air, wet- and dry-bulb temperatures in deg F.
 - f. Entering-air, wet- and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - h. Water flow rate in gpm.
 - i. Water pressure differential in feet of head or psig.
 - j. Entering-water temperature in deg F.
 - k. Leaving-water temperature in deg F.
 - l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig.
 - n. Refrigerant suction temperature in deg F.
 - o. Inlet steam pressure in psig.
- G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
- 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 2. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg.
 - f. Leaving-air static pressure in inches wg.
 - g. Air static-pressure differential in inches wg.
 - h. Low-fire fuel input in Btu/h.
 - i. High-fire fuel input in Btu/h.
 - j. Manifold pressure in psig.
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h.

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- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- J. Air-Terminal-Device Reports:

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1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft..
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.

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- f. Water flow rate in gpm.
- g. Water pressure differential in feet of head or psig.
- h. Required net positive suction head in feet of head or psig.
- i. Pump rpm.
- j. Impeller diameter in inches.
- k. Motor make and frame size.
- l. Motor horsepower and rpm.
- m. Voltage at each connection.
- n. Amperage for each phase.
- o. Full-load amperage and service factor.
- p. Seal type.

2. Test Data (Indicated and Actual Values):

- a. Static head in feet of head or psig.
- b. Pump shutoff pressure in feet of head or psig.
- c. Actual impeller size in inches.
- d. Full-open flow rate in gpm.
- e. Full-open pressure in feet of head or psig.
- f. Final discharge pressure in feet of head or psig.
- g. Final suction pressure in feet of head or psig.
- h. Final total pressure in feet of head or psig.
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

M. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.15 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of at least **10** percent of air outlets.
 - b. Measure water flow of at least **5** percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.

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e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by:

a. Architect .

2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of:

a. Architect .

3. The following entity shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day:

a. Architect .

4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.16 ADDITIONAL TESTS

A. Within **90 days** of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

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- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

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SECTION 230713 - DUCT INSULATION

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 insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
 - 6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
 - 7. Outdoor, concealed supply and return.
 - 8. Outdoor, exposed supply and return.
- B. Related Sections:
 - 1. Section 230716 "HVAC Equipment Insulation."
 - 2. Section 230719 "HVAC Piping Insulation."
 - 3. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

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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, dampers, specialties, and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. 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.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

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1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.8 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.9 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Aeroflex USA, Inc.; Aerocel.
- b. Armacell LLC; AP Armflex.
- c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.

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- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, **Type III with factory-applied FSK jacket**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. CertainTeed Corp.; SoftTouch Duct Wrap.
- b. Johns Manville; Microlite.
- c. Knauf Insulation; Friendly Feel Duct Wrap.
- d. Manson Insulation Inc.; Alley Wrap.
- e. Owens Corning; SOFTR All-Service Duct Wrap.

- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation **with factory-applied ASJ**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. CertainTeed Corp.; Commercial Board.
- b. Fibrex Insulations Inc.; FBX.
- c. Johns Manville; 800 Series Spin-Glas.
- d. Knauf Insulation; Insulation Board.
- e. Manson Insulation Inc.; AK Board.
- f. Owens Corning; Fiberglas 700 Series.

- I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Armacell LLC; Tubolit.
- b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to **1700 deg F**. Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction

1. Products: Subject to compliance with requirements, provide the following:

- a. Johns Manville; Super Firetemp M.

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- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide **2**-hour fire rating by an NRTL acceptable to authorities
 - 1. Products: Subject to compliance with requirements, provide one of the following :
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
 - d. Thermal Ceramics; FireMaster Duct Wrap.
 - e. 3M; Fire Barrier Wrap Products.
 - f. Unifrax Corporation; FyreWrap.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact 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).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - 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).
- D. FSK Jacket Adhesive, and ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.

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- b. Eagle Bridges - 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).

2.4 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. Products: Subject to compliance with requirements, provide one of the following:
- a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
2. 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.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

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4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. 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).
 2. Products: Subject to compliance with requirements, provide one of 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.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
 5. Color: White.

2.6 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: **Minus 40 to plus 250 deg F.**
 5. Color: Aluminum.
 6. For indoor applications, sealants shall have a VOC content of **420** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Metal Jacket:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 - 2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. **Sheet and roll stock ready for shop or field sizing**
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: **3-mil-thick, heat-bonded polyethylene and kraft paper.**
 - d. Moisture Barrier for Outdoor Applications: **3-mil-thick, heat-bonded polyethylene and kraft.**

2.9 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - 2. Width: 3 inches (75 mm).
 - 3. Thickness: 6.5 mils (0.16 mm).
 - 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

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5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.10 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with wing seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-)diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.

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- 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, **0.030 inch** thick by **2 inches** square.
 - c. Spindle: **Copper- or zinc-coated, low-carbon steel** fully annealed, **0.106-inch-** diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, **0.030 inch** thick by **1-1/2 inches** in diameter.
 - c. Spindle: Nylon, **0.106-inch-** diameter shank, length to suit depth of insulation indicated, up to **2-1/2 inches**.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

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5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
 - 2) GEMCO; Peel & Press.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, **0.030 inch** thick by **2 inches** square.
 - c. Spindle: **Copper- or zinc-coated, low-carbon steel**, fully annealed, **0.106-inch-** diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.

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- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at:
 - a. **2 inches o.c.**
 - b. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

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- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches** below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches**.
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least **2 inches**.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match

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adjacent duct insulation. Overlap damper sleeve and duct insulation at least **2 inches**.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for:
 - a. **100** percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions **18 inches** and smaller, place pins along longitudinal centerline of duct. Space **3 inches** maximum from insulation end joints, and **16 inches** o.c.
 - b. On duct sides with dimensions larger than **18 inches**, place pins **16 inches** o.c. each way, and **3 inches** maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing **2 inches** from one edge and one end of insulation segment. Secure laps to adjacent insulation section with **1/2-inch** outward-clinching staples, **1 inch** o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

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- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below **50 deg F** at **18-foot** intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than **3 inches**.
5. Overlap unfaced blankets a minimum of **2 inches** on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of **18 inches** o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with **6-inch**-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced **6 inches** o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for:
 - a. 50 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions **18 inches** and smaller, place pins along longitudinal centerline of duct. Space **3 inches** maximum from insulation end joints, and **16 inches** o.c.
 - b. On duct sides with dimensions larger than **18 inches**, space pins **16 inches** o.c. each way, and **3 inches** maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing **2 inches** from one edge and one end of insulation segment. Secure laps to adjacent insulation section with **1/2-inch** outward-clinching

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staples, **1 inch** o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with **6-inch**-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced **6 inches** o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with **2-inch** overlap at seams and joints.
 2. Embed glass cloth between two **0.062-inch**-thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with **1-1/2-inch** laps at longitudinal seams and **3-inch**-wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with **1-inch** overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with **2-inch** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands **12 inches** o.c. and at end joints.

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3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: **Two** finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
 - B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
 - C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
 - D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency:
 - a. Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to **one** location for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

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3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

C. Insulation shall have an R value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. All supply and return ducts and plenums shall be insulated with not less than R-6 insulation.

B. Concealed, round and flat-oval, supply-air duct insulation shall be **one of** the following:

1. Flexible Elastomeric: **1-1/2 inch** thick.
2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

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- C. Concealed, round and flat-oval, return-air duct insulation shall be **one of** the following:
 - 1. Flexible Elastomeric: **1-1/2 inch** thick.
 - 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

- D. Concealed, round and flat-oval, outdoor-air and combustion-air duct insulation shall be **one of** the following:
 - 1. Flexible Elastomeric: **1-1/2 inch** thick.
 - 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

- E. Concealed, round and flat-oval, exhaust-air duct insulation shall be **one of** the following:
 - 1. Flexible Elastomeric: **1-1/2 inch** thick.
 - 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

- F. Concealed, rectangular, supply-air duct insulation shall be **one of** the following:
 - 1. Flexible Elastomeric: **1-1/2 inch** thick.
 - 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

- G. Concealed, rectangular, return-air duct insulation shall be **one of** the following:
 - 1. Flexible Elastomeric: **1-1/2 inch** thick.
 - 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

- H. Concealed, rectangular, outdoor-air and combustion-air duct insulation shall be **one of** the following:
 - 1. Flexible Elastomeric: **1-1/2 inch** thick.
 - 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

- I. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation:
 - a. Fire-rated **blanket**; thickness as required to achieve 2-hour fire rating.
 - 1. Ductwork is to be wrapped with two layers of approved fire wrap that meets ASTM E-2336.

- J. Concealed, supply-air plenum insulation shall be **one of** the following:
 - 1. Flexible Elastomeric: **1-1/2 inch** thick.
 - 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

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- K. Concealed, return-air plenum insulation shall be **one of** the following:
1. Flexible Elastomeric: **1-1/2 inch** thick.
 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.
- L. Concealed, outdoor-air plenum insulation shall be **one of** the following:
1. Flexible Elastomeric: **1-1/2 inch** thick.
 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.
- M. Exposed, round and flat-oval, supply-air duct insulation shall be **one of** the following:
1. Flexible Elastomeric: **1-1/2 inch** thick.
 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.
 3. Mineral-Fiber Board: **1-1/2 inches** thick and **3-lb/cu. ft.** nominal density.
- N. Exposed, round and flat-oval, return-air duct insulation shall be **one of** the following:
1. Flexible Elastomeric: **1-1/2 inch** thick.
 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.
 3. Mineral-Fiber Board: **1-1/2 inches** thick and **3-lb/cu. ft.** nominal density.
- O. Exposed, round and flat-oval, outdoor-air and combustion-air duct insulation shall be **one of** the following:
1. Flexible Elastomeric: **1-1/2 inch** thick.
 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.
 3. Mineral-Fiber Board: **1-1/2 inches** thick and **3-lb/cu. ft.** nominal density.
- P. Exposed, rectangular, supply-air duct insulation shall be **one of** the following:
1. Flexible Elastomeric: **1-1/2 inch** thick.
 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.
 3. Mineral-Fiber Board: **1-1/2 inches** thick and **3-lb/cu. ft.** nominal density.
- Q. Exposed, rectangular, return-air duct insulation shall be **one of** the following:
1. Flexible Elastomeric: **1-1/2 inch** thick.
 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.
 3. Mineral-Fiber Board: **1-1/2 inches** thick and **3-lb/cu. ft.** nominal density.

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- R. Exposed, rectangular, outdoor-air and combustion-air duct insulation shall be **one of** the following:
 - 1. Flexible Elastomeric: **1-1/2 inch** thick.
 - 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.
 - 3. Mineral-Fiber Board: **1-1/2 inches** thick and **3-lb/cu. ft.** nominal density.

- S. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation:
 - a. Fire-rated **blanket**, thickness as required to achieve 2-hour fire rating.

- T. Exposed, supply-air plenum insulation shall be[**one of**] the following:
 - 1. Flexible Elastomeric: **1-1/2 inch** thick.
 - 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.
 - 3. Mineral-Fiber Board: **1-1/2 inches** thick and **2-lb/cu. ft.** nominal density.

- U. Exposed, return-air plenum insulation shall be **one of** the following:
 - 1. Flexible Elastomeric: **1-1/2 inch** thick.
 - 2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.
 - 3. Mineral-Fiber Board: **1-1/2 inches** thick and **2-lb/cu. ft.** nominal density.

3.13 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. All outdoor supply and return ducts and plenums shall be insulated with not less than R-12 insulation.
- C. Exposed, round and flat-oval, supply-air duct insulation shall be **one of** the following:
 - 1. Flexible Elastomeric: **3 inch** thick.
 - 2. Polyolefin: **3 inch** thick.

- D. Exposed, round and flat-oval, return-air duct insulation shall be **one of** the following:
 - 1. Flexible Elastomeric: **3 inch** thick.
 - 2. Polyolefin: **3 inch** thick.

- E. Exposed, rectangular, supply-air duct insulation shall be **one of** the following:

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1. Flexible Elastomeric: **3 inch** thick.
2. Polyolefin: **3 inch** thick.

F. Exposed, rectangular, return-air duct insulation shall be **one of** the following:

1. Flexible Elastomeric: **3 inch** thick.
2. Polyolefin: **3 inch** thick.

G. Exposed, supply-air plenum insulation shall be **one of** the following:

1. Flexible Elastomeric: **3 inch** thick.
2. Polyolefin: **3 inch** thick.

H. Exposed, return-air plenum insulation shall be **one of** the following:

1. Flexible Elastomeric: **3 inch** thick.
2. Polyolefin: **3 inch** thick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:

1. Aluminum, Corrugated: **0.032 inch** thick.

D. Ducts and Plenums, Exposed, up to **48 Inches** in Diameter or with Flat Surfaces up to **72 Inches**:

1. Aluminum, **Corrugated: 0.032 inch** thick.

E. Ducts and Plenums, Exposed, Larger Than **48 Inches** in Diameter or with Flat Surfaces Larger Than **72 Inches**:

1. Aluminum, with **1-1/4-Inch- Deep Corrugations: 0.032 inch** thick.

END OF SECTION 230713

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SECTION 230719 - HVAC PIPING INSULATION

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 insulating the following HVAC piping systems:
 - 1. Heating hot-water piping.

1.3 DEFINITIONS:

- A. Refer to Section 230500 "Common Work Results for HVAC".

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

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1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. 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.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.7 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.9 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

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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.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Insulation for below-ambient service requires a vapor-barrier.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. 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.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Calcium Silicate:
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Industrial Insulation Group (IIG); Thermo-12 Gold.
 - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

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- H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553,
1. Type II and ASTM C 1290, Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoffTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- J. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000-Degree Pipe Insulation.
 - c. Manson Insulation Inc.; Alley-K.
 - d. Owens Corning; Fiberglas Pipe Insulation.
 - e. Type I, **850 deg F** Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, **Type I, Grade A:**
 - 1) with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied:
1. **ASJ** complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is **2.5 lb/cu. ft.** or more. Thermal conductivity (k-value) at **100 deg F** is **0.29 Btu x in./h x sq. ft. x deg F** or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

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- L. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Ramco Insulation, Inc.; Super-Stik.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 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 **50 to 800 deg F**.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
 - b. Eagle Bridges - Marathon Industries; 290.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
 - d. Mon-Eco Industries, Inc.; 22-30.
 - e. Vimasco Corporation; 760.
 - 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).
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.

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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).
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - 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, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - 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, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.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).
- 2.4 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).

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- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, **0.013 perm** at **43-mil** dry film thickness.
 - 3. Service Temperature Range: **Minus 20 to plus 180 deg F.**
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - 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 F 1249, **0.05 perm** at **30-mil** dry film thickness.
 - 3. Service Temperature Range: **Minus 50 to plus 220 deg F.**
 - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 5. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, **1.8 perms** at **0.0625-inch** dry film thickness.

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3. Service Temperature Range: **Minus 20 to plus 180 deg F.**
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 SEALANTS

A. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 40 to plus 250 deg F.**
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.

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2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Black
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. 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**.
 3. Thickness: **11.5 mils**.
 4. Adhesion: **90 ounces force/inch** in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: **40 lbf/inch** in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: **2 inches**.
 3. Thickness: **6 mils**.
 4. Adhesion: **64 ounces force/inch** in width.
 5. Elongation: 500 percent.

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6. Tensile Strength: **18 lbf/inch** in width.

2.9 SECUREMENTS

- A. Staples: Outward-clinching insulation staples, nominal **3/4-inch-** wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

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- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with **3-inch-** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches** o.c.
 - 3. Overlap jacket longitudinal seams at least **1-1/2 inches**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at
 - a. **2 inches o.c.**
 - b. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

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5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches** below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.

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2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches**.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistant joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe

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- insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

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4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least **2 inches** over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at **12-inch** intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least **3 inches**. Secure inner layer with wire spaced at **12-inch** intervals. Secure outer layer with stainless-steel bands at **12-inch** intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least **1 inch**. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

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D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

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4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at **6 inches** o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch**, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

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2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with **1-inch** overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with **2-inch** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands **12 inches** o.c. and at end joints.

3.10 FINISHES

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 1. Flat Acrylic Finish: **Two** finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

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- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

- 3.12 Insulation shall have a k value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).

- 3.13 INDOOR PIPING INSULATION SCHEDULE
 - A. Heating-Hot-Water Supply and Return, **200 Deg F** and Below:
 - 1. **NPS 1 1/2** and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I:
 - 1) 1-1/2 inch thick
 - 2. Greater than **NPS 1-1/2 inch** : Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I or Pipe and Tank Insulation:
 - 1) **2 inches** thick
 - 3. Insulation for runouts not exceeding **48 inches** in length for connection to equipment shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: **1 inch** thick.

- 3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE
 - A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
 - B. If more than one material is listed, selection from materials listed is Contractor's option.
 - C. Piping, Concealed:
 - 1. None.
 - D. Piping, Exposed:
 - 1. **PVC:**
 - a. White: **30 mils** thick.

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3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. None.
- D. Piping, Exposed:
 - 1. Aluminum, Stucco Embossed: **0.016 inch** thick.

3.16 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 230719

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SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes commissioning process requirements for the following HVAC&R systems, assemblies, and equipment:
 - 1. Energy supply systems, including:
 - a. gas supply
 - 2. Distribution systems, including:
 - a. air distribution (heating and cooling) systems
 - b. hot-water distribution systems
 - c. exhaust systems
 - d. air-handling units
 - 3. Terminal and packaged units, including:
 - a. variable-air-volume (VAV) boxes
 - b. radiator panels
 - 4. Controls and instrumentation, including:
 - a. Building automation system (BAS)
 - b. Automatic temperature controls (ATC)
 - c. energy monitoring and control system
 - 5. Systems testing and balancing verification, including:
 - a. heating-water piping systems
 - b. domestic hot-water circulating systems
 - c. supply-air systems
 - d. return-air systems
 - e. exhaust-air systems
- B. Related Requirements:

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1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements and Commissioning Coordinator responsibilities.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. DDC: Direct digital controls.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. "Systems," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- E. TAB: Testing, adjusting, and balancing.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For BAS and HVAC&R Testing Technician.
- B. Construction Checklists: See related Sections for technical requirements for the following construction checklists:
 1. Vibration and seismic controls for HVAC&R piping and equipment.
 2. Instrumentation and control for HVAC&R.
 3. Heating-water piping and accessories.
 4. Metal ducts and accessories.
 5. Fans.
 6. Particulate air filtration.
 7. Air-handling units.

1.5 QUALITY ASSURANCE

- A. BAS Testing Technician Qualifications: Technicians to perform BAS construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:
 1. Journey-level or equivalent skill level with knowledge of BAS, HVAC&R, electrical concepts, and building operations.

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2. Minimum **three years'** experience installing, servicing, and operating systems manufactured by approved manufacturer.
 3. International Society of Automation (ISA) Certified Control Systems Technician (CCST) Level I.
- B. HVAC&R Testing Technician Qualifications: Technicians to perform HVAC&R construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:
1. Journey-level or equivalent skill level. Vocational School four-year program graduate or an Associates degree in mechanical systems, air conditioning, or similar field. Degree may be offset by three years' experience in servicing mechanical systems in the HVAC industry. Generally, required knowledge includes HVAC&R systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of HVAC&R equipment, assemblies, and systems.
 2. Minimum **three years'** experience installing, servicing, and operating systems manufactured by approved manufacturer.
 3. One of the following:
 - a. National Environmental Balancing Bureau (NEBB) Certified Testing, Adjusting, and Balancing Technician.
 - b. Associated Air Balance Council (AABC) Certified Test and Balance Technician.
 - c. Owner retains the right to waive NEBB or AABC Certification.
- C. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform HVAC&R commissioning work, perform the following:
1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:
 - a. Equipment/instrument identification number.
 - b. Planned commissioning application or use.
 - c. Manufacturer, make, model, and serial number.
 - d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
 2. Test equipment and instrumentation shall meet the following criteria:
 - a. Capable of testing and measuring performance within the specified acceptance criteria.
 - b. Be calibrated at the manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
 - c. Be maintained in good repair and operating condition throughout the duration of use on this Project.

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- d. Be recalibrated/repared if dropped or damaged in any way since last calibrated.

D. Proprietary Test Instrumentation and Tools:

- 1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the commissioning process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:
 - a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:
 - 1) Instrument or tool identification number.
 - 2) Equipment schedule designation of equipment for which the instrument or tool is required.
 - 3) Manufacturer, make, model, and serial number.
 - 4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.
 - b. Include a separate list of proprietary test instrumentation and tools in the operation and maintenance manuals.
 - c. HVAC&R proprietary test instrumentation and tools become the property of Owner at the time of Substantial Completion.

1.6 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents and approved Shop Drawings and submittals.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.
- C. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

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- D. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.
- F. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.
- G. Construction Checklists: Prepare and submit detailed construction checklists for HVAC&R systems, subsystems, equipment, and components.
 - 1. Contributors to the development of construction checklists shall include, but are not limited to, the following:
 - a. HVAC&R systems and equipment installers.
 - b. TAB technicians.
 - c. HVAC&R instrumentation and controls installers.
- H. Perform tests using design conditions, whenever possible.
 - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by Commissioning Coordinator and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
 - 2. Commissioning test procedures may direct that set points be altered when simulating conditions is impractical.
 - 3. Commissioning test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.
- J. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.
- K. Coordinate schedule with, and perform the following activities at the direction of, Commissioning Coordinator.
- L. Comply with construction checklist requirements, including material verification, installation checks, start-up, and performance tests requirements specified in Sections specifying HVAC systems and equipment.

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- M. Provide technicians, instrumentation, tools, and equipment to complete and document the following:
 - 1. Performance tests.
 - 2. Demonstration of a sample of performance tests.
 - 3. Commissioning tests.
 - 4. Commissioning test demonstrations.

3.2 TAB COMMISSIONING TESTS

A. TAB Verification:

- 1. Prerequisites: Completion of "Examination" Article requirements and correction of deficiencies, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
- 2. Completion of "Preparation" Article requirements for preparation of a TAB plan that includes strategies and step-by-step procedures, and system-readiness checks and reports, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
- 3. Scope: HVAC&R air systems and hydronic piping systems.
- 4. Purpose: Differential flow relationships intended to maintain air pressurization differentials between the various areas of Project.
- 5. Conditions of the Test:
 - a. Commissioning Test Demonstration Sampling Rate: As specified in "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
 - b. Systems operating in full heating mode **with minimum outside-air volume.**
 - c. Systems operating in full cooling mode **with minimum outside-air volume.**
 - d. For measurements at air-handling units with economizer controls; systems operating in economizer mode with 100 percent outside air.
- 6. Acceptance Criteria:
 - a. Under all conditions, rechecked measurements comply with "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
 - b. Additionally, no rechecked measurement shall differ from measurements documented in the final report by more than two times the tolerances allowed.
 - c. Under all conditions, where the Contract Documents indicate a differential in airflow between supply and exhaust and/or return in a space, the differential relationship shall be maintained.

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3.3 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in HVAC boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.
- B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls." Assist the CxA with preparation of testing plans.
- C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R **contractor** shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
 - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 - 2. Description of equipment for flushing operations.
 - 3. Minimum flushing water velocity.
 - 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- E. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- F. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

3.4 TERMINAL UNIT EQUIPMENT COMMISSIONING TESTS

- A. Variable-Air-Volume Terminal Air Units with Coils:
 - 1. Prerequisites: Installation verification of the following:
 - a. Occupancy Input Device: Occupancy sensor.

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- b. Occupancy Output Device: DDC system binary output.
 - c. Room Temperature Input Device: **Room thermostat**
 - d. Room Temperature Output Device: **Electronic** damper actuators and control-valve operators.
 - e. Display the following at the operator's workstation:
 - 1) Room/area served.
 - 2) Room occupied/unoccupied.
 - 3) Room temperature indication.
 - 4) Room temperature set point.
 - 5) Room temperature set point, occupied.
 - 6) Room temperature set point, unoccupied.
 - 7) Air-damper position as percentage open.
 - 8) Control-valve position as percentage open.
2. Scope: Variable-air-volume terminal air units with **hydronic** coils in supply-air systems, and associated controls.
3. Purpose:
- a. Occupancy-dependent room temperature set-point reset.
 - b. Room temperature control.
4. Conditions of the Test:
- a. Commissioning Test Demonstration Sampling Rate: **10** percent of each model/size unit.
 - b. Temperature Control - Occupied: Start with the room unoccupied. Occupy the room and observe the change to occupied status. Observe temperature control until room temperature is stable at occupied set point plus or minus **1.0 deg F (0.6 deg C)**.
 - c. Temperature Control - Unoccupied: Start with the room occupied. Vacate the room and observe the change to unoccupied status. Observe temperature control until room temperature is stable at unoccupied set point plus or minus **1.0 deg F (0.6 deg C)**
5. Acceptance Criteria:
- a. Temperature Control - Occupied:
 - 1) Control system status changes from "occupied" to "unoccupied" after the specified time.
 - 2) Room temperature is stable at occupied set point plus or minus **1.0 deg F (0.6 deg C)** within **10** minutes of occupancy. Room temperature does not overshoot or undershoot set point by more than **2.0 deg F (1.1 deg C)** during transition.
 - b. Temperature Control - Unoccupied:
 - 1) Control system status changes from "unoccupied" to "occupied" **after five minutes of continuous occupancy**.
 - 2) Room temperature is stable at unoccupied set point plus or minus **1.0 deg F (0.6 deg C)** within **30** minutes of occupancy.

3.5 AIR-HANDLING SYSTEM COMMISSIONING TESTS

A. Supply Fan(s) Variable-Volume Control:

1. Prerequisites: Installation verification of the following:
 - a. Volume Control Input Device: **Differential-pressure switch** sensing supply-duct static pressure referenced to conditioned-space static pressure.
 - b. Volume Control Output Device: **DDC system analog output** to modulating damper actuator. Set inlet guide vanes to **minimum** position when fan is stopped.
 - c. High-Pressure Input Device: Static-pressure transmitter sensing supply-duct static pressure referenced to static pressure outside the duct.
 - d. High-Pressure Output Device: **DDC system binary output** to **alarm panel**
 - e. Display the following at the operator's workstation:
 - 1) Supply-fan-discharge static-pressure indication.
 - 2) Supply-fan-discharge static-pressure set point.
 - 3) Supply-fan airflow rate.
 - 4) Supply-fan **speed**
2. Scope: Variable-air-volume supply fan units and associated controls.
3. Purpose:
 - a. Supply-air discharge static pressure control.
 - b. Response to excess supply-air discharge static pressure condition.
4. Conditions of the Test:
 - a. Minimum supply-air flow.
 - b. Midrange Supply-Air Flow: **50** percent of maximum.
 - c. Maximum supply-air flow.
 - d. Excess supply-air discharge static pressure.
5. Acceptance Criteria:
 - a. At all supply-air flow rates, and during changes in supply-air flow, discharge air static pressure is at set point plus or minus 2 percent.
 - b. Fan stops and an alarm is initiated at the operator's workstation when supply-air discharge static pressure is at the excess static pressure plus or minus 2 percent.

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SECTION 230900 – BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Facility Management and Control System (FMCS) Contractor shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control as herein specified. The system shall include all required computer software and licenses, hardware, controllers, sensors, transmission equipment, system workstations, local panels, conduit, wire, installation, engineering, database and setup, supervision, commissioning, acceptance test, training, warranty service and, at the owner's option, extended warranty service. Licenses for all software shall be registered to Intermountain Health Care. Include all upgrades for a period of two years.
- B. The system shall only employ BACnet or LonTalk communications in an open architecture with the capabilities to support a multi-vendor environment. The software package shall be sold and promoted by at least three independent controls manufacturers. It shall include the provisions to load and execute the toolsets of each of the three manufacturers including commissioning, configuring and programming of each manufacturer's equipment. The system shall be capable of integrating third party systems and utilizing the following standard protocols.
 - 1. BACnet communication according to ASHRAE standard ANSI/ASHRAE 135-2004.
 - 2. OPC server communications according to OPC Data Access 2.0 and Alarms and Events 1.0.
 - 3. LonWorks communication using LonTalk protocol.
 - 4. Modbus communication for integration to third party devices.
- C. The FMCS shall be web based and shall provide total integration of the facility infrastructure systems with user access to all system data either locally over a secure Intranet within the building or by remote access by a standard Web Browser over the Internet.
- D. The FMCS shall demonstrate, with (3) proof sources, integration with HVAC industry open standard protocols, including LonMark, BACnet, ModBus, OPC and Internet standard SQL database and HTTP / HTML / XML text formats.
- E. The FMCS shall communicate to third party systems on this project including VFD's, boilers, air handling systems, chillers, fuel systems, medical gas, air compressor, vacuum pumps, emergency generators, computer room units, transfer switches, fire-life safety systems and other building management related devices using any of the open, interoperable communication protocols referenced in Paragraph D.

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- F. All materials and equipment used shall be standard components, regularly manufactured with standard part numbers and owners manuals for this and/or other systems. One of a kind, third party or custom integrations devices designed specially for this project will not be allowed.
- G. All control wiring shall be installed in **BLUE** Conduit.
- 1.2 RELATED WORK SPECIFIED ELSEWHERE:
 - A. Drawings and general provisions of the Contract, including General and supplementary Conditions and Division-1 specification sections, apply to work of this section.
 - B. Products furnished but not installed under this section:
 - 1. Valves, flow switches, flow sensors, thermowells and pressure taps to be installed under section 15000.
 - 2. Automatic dampers to be installed under section 15000.
 - C. Coordination with electrical:
 - 1. Installation of all line voltage power wiring by division 26.
 - 2. Each motor starter provided under Division 26, shall be furnished with individual control power transformer to supply 120 volt control power and auxiliary contacts (one N.O. and one N.C.) for use by this section.
- 1.3 QUALITY ASSURANCE
 - A. The system shall be furnished, engineered, and installed by the manufacturers' locally authorized representative. The controls contractor shall have factory-trained technicians to provide instruction, routine maintenance, and emergency service within 24 hours upon receipt of request.
 - B. At the time of bid, all FMCS Application Specific Controllers and Programmable Equipment Controllers shall be listed as follows:
 - 1. Underwriters Laboratory, UL 916
 - 2. FCC Regulation, Part 15, Class B
- 1.4 OWNER SPECIFICATION COMPLIANCE
 - A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.
- 1.5 SUBMITTALS

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- A. Submit 6 complete sets of documentation in the following phased delivery schedule:
 - 1. Valve and damper schedules
 - 2. Equipment data cut sheets
 - 3. System schematics, including:
 - a. sequence of operations
 - b. point names
 - c. point addresses
 - d. point to point wiring
 - e. interface wiring diagrams
 - f. panel layouts
 - g. system riser diagrams
 - 4. AutoCAD® compatible as-built drawings.
 - 5. ATC Submittals shall be completed using HVAC Solution Software. AutoCAD files will be accepted on components and systems which HVAC Solution does not support. The main Bulk of the submittals shall be submitted using HVAC Solution.
- B. Upon project completion, submit operation and maintenance manuals, consisting of the following:
 - 1. Index sheet, listing contents in alphabetical order
 - 2. Manufacturer's equipment parts list of all functional components of the system, disk of system schematics, including wiring diagrams
 - 3. Description of sequence of operations
 - 4. As-Built interconnection wiring diagrams
 - 5. User's documentation containing product, system architectural and programming information.
 - 6. Trunk cable schematic showing remote electronic panel locations, and all trunk data
 - 7. List of connected data points, including panels to which they are connected and input device (ionization detector, sensors, etc.)
 - 8. Conduit routing diagrams
 - 9. Copy of the warranty/guarantee
 - 10. Operating and maintenance cautions and instructions
 - 11. Recommended spare parts list

PART 2 - PRODUCTS

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- 2.1 ACCEPTABLE MANUFACTURERS
 - A. Sneider & TAC Controls Installed by Utah Yamas Controls
 - B. Johnson Controls installed by the Local Johnson Controls Branch Office
 - C. Johnson Controls by CCI Mechanical
 - D. All sub-contractors if used for installation of the control system shall have a minimum of 10 years experience and shall have installed at least 10 other control systems for the controls contractor of the same type.
- 2.2 The Facility Management Control System (FMCS) shall be comprised of a network of interoperable, stand-alone digital controllers. The FMCS shall incorporate LonWorks technology using Free Topology Transceivers (FTT-10), or BACnet MSTP485 or Ethernet in all unitary, terminal and other device controllers. The system shall include:
 - A. Programmable Equipment Controllers (PEC's) for control of primary mechanical systems and distributed system applications. Controllers shall be fully programmable to create custom control solutions.
 - B. Network Area Controllers (NAC's) for distributed system applications, databases and networking functions.
 - C. Application Specific Controllers (ASC's) for control of VAV terminal units, Fan coil terminal units, Unit Vent terminal units, Heat Pump units and other terminal equipment.
 - D. Graphical User Interface (GUI), which includes the hardware and software necessary for a user to interface with the control system and devices.
- 2.3 The controller network shall use twisted pair wiring or loop. The PEC and ASC network shall communicate at a minimum 78Kbps using BACnet or Lontalk. The GUI and NAC shall reside on an Ethernet backbone.
- 2.4 All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices.
- 2.5 NETWORK AREA CONTROLLER (NAC)
 - A. The Network Area Controller (NAC) shall provide the interface between the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:
 1. Calendar functions
 2. Scheduling

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3. Trending
4. Alarm monitoring and routing
5. Time synchronization
6. Integration of LonWorks controller data
7. Integration of BACnet and MODBUS networks
- B. The NAC shall provide multiple, concurrent user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
- C. The NAC shall support standard Web browser access via the Intranet/Internet. It shall be capable of supporting multiple users, expandable to fifty.
- D. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 1. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
 2. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:
 - a. To alarm
 - b. Return to normal
 - c. To fault
 3. Provide for the creation of an unlimited number of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
 4. Provide timed (schedule) routing of alarms by class, object, group, or node.
 5. Provide alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
- E. Alarms shall be annunciated in any of the following manners as user defined:
 1. Screen message text
 2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - a. Day of week
 - b. Time of day
 - c. Recipient

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3. Pagers via paging services that initiate a page on receipt of email message
 4. Graphic with flashing alarm object(s)
 5. Printed message, routed directly to a dedicated alarm printer
 6. Cell phones
- F. The following shall be recorded by the NAC for each alarm (at a minimum):
1. Time and date
 2. Location (building, floor, zone, office number, etc.)
 3. Equipment (air handler #, accessway, etc.)
 4. Acknowledge time, date, and user who issued acknowledgement.
- G. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
- H. A log of all alarms shall be maintained by the NAC and/or a server and shall be available for review by the user.
- I. Provide a "query" feature to allow review of specific alarms by user defined parameters.
- J. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
- K. An Error Log to record system errors shall be provided and available for review by the user.
- L. Data Collection and Storage
1. The NAC shall collect data for any property of any object and store this data for future use.
 2. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:
 - a. Designating the log as interval or deviation.
 - b. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
 - c. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
 - d. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
 - e. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

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3. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a standard Web Browser.
 4. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
 5. All log data shall be available to the user in the following data formats:
 - a. HTML
 - b. XML
 - c. Plain Text
 - d. Comma or tab separated values
 6. The NAC shall have the ability to archive it's log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:
 - a. Archive on time of day
 - b. Archive on user-defined number of data stores in the buffer (size)
 - c. Archive when buffer has reached it's user-defined capacity
- M. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached it's user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
1. Time and date
 2. User ID
 3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.
- N. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time of day.
1. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.
 2. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.
- 2.6 PROGRAMMABLE EQUIPMENT CONTROLLERS (PEC)
- A. Programmable Equipment Controllers (PEC's) shall be stand-alone, multi-tasking, real-time digital control processors.
 - B. The PEC's shall communicate via BACnet communication according to ASHRAE standard ANSI/ASHRAE 135-2004 or Lonworks FT110.

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- C. The PEC must communicate peer-to-peer with all of the network application specific, programmable controllers and third party LonMark devices.
 - D. The PEC software database must be able to execute all of the specified mechanical system controls functions. The programming software shall be able to bundle software logic to simplify control sequencing. All values, which make up the PID output value, shall be readable and modifiable at a workstation or portable service tool. Each input, output, or calculation result shall be capable of being shared/bound with any controller or interface device on the network.
 - E. Provide programming, engineering, and configuration tools used for the project duly licensed to the owner for owner's use.
 - F. PEC's shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
 - G. A single process shall be able to incorporate measured or calculated data from any and all other PEC's on the network. In addition, a single process shall be able to issue commands to points in any and all other PEC's on the network.
 - H. Each PEC shall support firmware upgrades without the need to replace hardware.
 - I. Each PEC shall continuously perform self-diagnostics, which include communication diagnosis and diagnosis of all components.
 - J. In the event of the loss of normal power, there shall be an orderly shutdown of all PEC's to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
 - 1. Upon restoration of normal power, the PEC shall automatically resume full operation without manual intervention.
 - 2. All PEC's control programming and databases must be stored in Flash memory, therefore eliminating data loss, downtime and re-load time.
 - K. Provide a separate PEC for each AHU or other HVAC system such that the inputs, calculations, and outputs shall reside on a single controller.
- 2.7 APPLICATION SPECIFIC CONTROLLERS (ASC)
- A. Each Application Specific Controller (ASC) shall operate as a stand-alone Lon Mark or BacNet controller capable of performing its specified control responsibilities independent of other controllers in the network. Each ASC shall be a minimum 16-BIT microprocessor based, multi-tasking, multi-user, real time digital control processor.
 - B. Controllers shall include all inputs and outputs necessary to perform the specified control sequences. Analog and digital outputs shall be industry standard signals such as 0-10V and 3-point floating control allowing for interface to a variety of industry standard modulating actuators. The ASC inputs and outputs shall consist of industry

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standards types. Inputs shall be electrically isolated from outputs, communications and power.

- C. All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the network is not acceptable.
- D. The control program shall reside in the ASC. The application program and the configuration information shall be stored in non-volatile memory with no battery back-up required.
- E. After a power failure the ASC must run the control application using the current setpoints and configuration. Reverting to default or factory setpoints are not acceptable.

2.8 GRAPHICAL USER INTERFACE SOFTWARE (GUI)

- A. Command of points from multiple manufacturers shall be transparent to the operator.
- B. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. The GUI software shall run on a Windows XP 32-bit operating system. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line FMCS alarms and monitoring information. If the software is unable to display several different types of displays at the same time, the FMCS contractor shall provide at least two operator workstations at each location specified.
- C. Real-Time Displays. The Graphical User Interface (GUI), shall at a minimum, support the following graphical features and functions:
 - 1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures and streaming video.
 - 2. Provide programming, engineering, and configuration tools used for the project duly licensed to the owner for owner's use.
 - 3. A gallery of HVAC and automation symbols shall be provided, including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams and symbols. The user shall have the ability to add custom symbols to the gallery as required.
 - 4. Graphic screens shall contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
 - 5. Graphics shall include layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

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6. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
 - a. Schedule times will be adjusted by mouse command using a graphical slider, without requiring any keyboard entry from the operator.
 - b. Holidays shall be set by mouse command using a graphical calendar, without requiring any keyboard entry from the operator.
7. Commands to start and stop binary objects shall be done by mouse command from the pop-up menu. No entry of text shall be required.
- D. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
 1. Create, delete or modify control strategies.
 2. Add/delete objects to the system.
 3. Tune control loops through the adjustment of control loop parameters.
 4. Enable or disable control strategies.
 5. Generate hard copy records or control strategies on a printer.
 6. Select points to be alarmable and define the alarm state.
 7. Select points to be trended over a period of time and initiate the recording of values automatically.
- E. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
- F. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
- G. All graphic displays shall be provided using web browser client as specified in 2.11.
- H. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.

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- I. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable. The alarm console shall be loaded and operated at the following locations.
- 2.9 WEB BROWSER CLIENTS
- A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer® or Netscape Navigator®. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
 - B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Web page access and control shall be from system Network Area Controllers, or the Workstation.
 - C. The Web browser shall provide the same system view, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
 - D. The Web browser client shall support at a minimum, the following functions:
 1. User log-on identification and password security shall be required and implemented using Java authentication and encryption techniques to prevent unauthorized access. If an unauthorized user attempts access, a blank web page shall be displayed.
 2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
 3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
 4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client machine are not acceptable.
 5. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
 6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - a. Modify in a graphical manner, common application objects, such as schedules, calendars, and set points. Schedule times will be adjusted by mouse command using a graphical slider, without requiring any keyboard

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- entry from the operator. Holidays shall be set by mouse command using a graphical calendar, without requiring any keyboard entry from the operator.
 - b. Commands to start and stop binary objects shall be done by mouse command right-click of the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 - c. View logs and charts
 - d. View and acknowledge alarms
 - 7. The system shall provide the capability to specify a user's home page (as determined by the log-on user identification). From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
 - 8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.
- 2.10 PROJECT SPECIFIC WEB PAGES:
- A. Home page shall include a campus layout of the individual buildings at the site. Once an individual building is selected the following minimum web-based tree structure shall be provided:
 - 1. Documents Page: The document page shall include the O&M Manuals for the control system in PDF format along with AutoCAD drawings for each drawing provided in the control system O&M Manual. This document page shall include links between the control diagrams and associated data sheet in PDF format, such that the system user shall be able to click on the control device and retrieve, in PDF format, the factory O&M sheets associated with that device.
 - 2. Station Functions:
 - a. Logging separate sheet of station functions for a particular selected building shall be the viewing of one or more logs or the creation of logs in which any value at any point, or the mode of any point, shall be selected via the web to be trended against any other point with an adjustable frequency in seconds, minutes, hours or days.
 - b. The alarm acknowledgement via the web shall allow the viewing and acknowledgement of the alarms.
 - c. Audit log shall be provided via the web to show the operator actions as well as other audit logs as specified in section 2.4 Network Area Controller (NAC) paragraph "M" Data Collection and Storage.
 - 3. Floor Plans:
 - a. AutoCAD drawings of floor plans shall be provided in the control system such that via the web the user shall be able to turn layers on and off on the mechanical floor plans. These floor plans shall also include an overlay of the temperature control as-built wiring for the project showing thermostat locations, communication runs, transformer locations, controller locations, etc.

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- b. Floor Display Summaries. The operator shall be able to select floor plans displaying the following formats:
 - 1) All zone temperatures
 - 2) All zone heating percentages
 - 3) All zone cooling percentages
 - 4) All zone room names and numbers as per architectural matrix and owner input.
 - 5) All zones cfm delivered.
4. Upon selecting a graphical floor plan layout the web page shall show all the zone temperature sensor locations on the floor. By clicking on the zone temperature location, an individual VAV box graphic shall be displayed with the following attributes:
 - a. A manual menu that shall allow the operator to manually set the air flow set point, space temperature set point, damper position, cooling percentage, heating percentage, and zero the box.
 - b. A 24 hour log chart that shows space temperature history, flow history, and allows the operator to build custom charts by comparing this log to other associated selectable logs.
 - c. A display of the VAV box discharge temperature, air handler discharge temperature, space temperature, and space temperature set point.
 - d. A bar graph that shows actual CFM, current air flow, and current air floor set point, percentage of heating and cooling in a thermometer-like fashion and changes color based on heating or cooling mode.
 - e. The damper position, reheat valve position, occupancy status, room name and heating/cooling mode shall also be shown.
5. Systems:
 - a. On selecting the systems menu, a tree structure shall allow the operator to select the air handlers, chillers, control valves, heat exchangers, med gas, boilers, fuel system, emergency generators and transfer switches, etc. systems associated with that building. The graphics shall also show the piping and ductwork associated with the air handler as well as the safeties, temperature sensors, humidity sensors, dampers, VFD's, associated with that fan system. See points lists for specifics. Each system in the points list shall be treated as a branch of the above tree.
 - b. All devices that provide dynamic function in the primary equipment, i.e., fans, pumps, coils, dampers shall be dynamic in nature showing their operating status/percentage of capacity by movement on the web page.
 - c. The set points for the various control loops shall be adjustable via the web page. Individual controlled devices, i.e., valves, dampers, fans shall be controlled via the web page and be stopped or started or placed in a command state or percentage of value output.

2.11 FIELD DEVICES

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- A. Provide automatic control valves, automatic control dampers, thermostats, clocks, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer.
- B. Temperature Sensors
 - 1. Temperature Sensors: Temperature sensors shall be linear precision elements with ranges appropriate for each specific application.
 - 2. Space (room) sensors shall be available with setpoint adjustment and override switch.
 - 3. Duct mounted averaging sensors shall utilize a sensing element incorporated in a copper capillary with a minimum length of 20 feet. The sensor shall be installed according to manufacture recommendation and looped and fastened at a minimum of every 36 inches.
 - 4. Sunshields shall be provided for outside air sensors.
 - 5. Thermo-wells for all immersion sensors shall be stainless steel or brass as required for the application.
- C. Humidity Sensors: Humidity sensors shall be of the solid-state type using a capacitance-sensing element. The sensor shall vary the output voltage with a change in relative humidity. Room humidity sensors shall have a minimum range of 10% to 90% \pm 5%. Supply air humidity sensors shall have a range of 10% to 90% \pm 5%.
- D. Pressure Sensors: The differential pressure sensor shall be temperature compensated and shall vary the output voltage with a change in differential pressure. Sensing range shall be suitable for the application with linearity of 1.5% of full scale and offset of less than 1% of full scale. Sensor shall be capable of withstanding up to 150% of rated pressure without damage.
- E. Flat plate (flush mount) temperature sensors shall be installed in public corridors, behavior health and any other locations where gurneys and/or carts could damage sensors and where public access of setpoint is not desired.
- F. Switches and Thermostats
 - 1. The FMCS Contractor shall furnish all electric relays and coordinate with the supplier of magnetic starters for auxiliary contact requirements. All electric control devices shall be of a type to meet current, voltage, and switching requirement of their particular application. Relays shall be provided with 24 VAC coils and contacts shall be rated at 10 amps minimum.
 - 2. Duct Smoke Detectors: Duct smoke detectors shall be supplied by others with an integral auxiliary contact to be used by the FMCS contractor to provide a digital input to the FMCS.
 - 3. Low Temperature Detection Thermostats: Shall be the manual reset type. The thermostat shall operate in response to the coldest one-foot length of the 20-foot

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sensing element, regardless of the temperatures at other parts of the element. The element shall be properly supported to cover the entire downstream side of the coil with a minimum of three loops. Separate thermostats shall be provided for each 25 square feet of coil face area or fraction thereof.

4. Differential Pressure Switches: Pressure differential switches shall have SPDT changeover contact, switching at an adjustable differential pressure setpoint.
 5. Current Sensing Relays: Motor status indications, where shown on the plans, shall be provided via current sensing relays. The switch output contact shall be rated for 30 VDC, .15 amps.
 6. Flow Switches: Motor status indications, where shown on the plans, shall be provided via flow switches. Flow switches shall be of the paddle type equipped with SPDT contacts to establish proof of flow.
 7. Carbon Monoxide Detector and Controller shall meet or exceed UL 2034 standard and OSHA standards for CO exposure. Controller shall be solid state sensor. Fan relay shall activate at 35 ppm of CO averaged over 5 minutes. Alarm relay shall activate at 100 ppm after 30 minutes. Approved manufacturers shall be Macurco, Inc or approved equal.
- G. OSA Air Flow Measurement and Air Handler
1. The monitor/controller shall be capable of direct measurement of airflow through an outside air inlet and produce dual outputs; one representing the measured airflow, and the other to control the inlet damper.
 2. The monitor/controller shall contain an integral multi-line liquid crystal display for use during the configuration and calibration processes, and to display two measured processes (volume, velocity, temperature) during normal operation. All configuration, output scaling, calibration, and controller tuning will be performed digitally in the on-board microprocessor via input pushbuttons.
 3. The monitor/controller shall measure inlet airflow with an accuracy of + or – 5% of reading over a range of 150-600 FPM or 250-1000 FPM or 500-3000 fpm and not have its reading affected by the presence of directional or gusting wind or turbulence. Measured airflow shall be density corrected for ambient temperature variances, and atmospheric pressure due to site altitude.
 4. The monitor/controller shall interface with existing building automation systems (BAS), accepting inputs for fan system start, economizer mode operation, and an external controller set point, and provide flow deviation alarm outputs.
 5. The sensors shall be constructed of materials that resist corrosion due to the presence of salt or chemicals in the air; all non-painted surfaces shall be constructed of stainless steel. The electronics enclosure shall be NEMA 1.
 6. The monitor/controller shall be the VOLU-flo/OAM as manufactured by Air Monitor Corporation, Santa Rosa, California.
- H. Supply Air and Return Air Monitoring

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1. Provide supply air and return air flow monitoring. The monitor/controller shall be the Veltron DPT 2500 Plus as manufactured by Air Monitor Corporation, Santa Rosa, California. $\frac{1}{4}\%$ Accurate, Automatic Zero, has display.
 2. Provide Valupress/FI on fan inlets on supply air and return air.
- I. Control Valves
1. General: Control Valves up to 4 inches shall be globe valves and shall be sized for a 3 to 5 psi pressure drop. Valves shall be packless, modulating, electrically or magnetically actuated, with a control rangeability of 100 to 1. These valves shall have equal percentage flow characteristics in relationship to valve opening.
 2. $\frac{1}{2}$ inch to 4 inch: Valves shall be equipped with handwheel, or manual position mounted dial adjacent to valve, to allow manual positioning of valve in absence of control power. (Valves with a rangeability of less than 200 to 1 shall utilize two valves in a $\frac{1}{3}$ – $\frac{2}{3}$ parallel arrangement in order to achieve control rangeability).
 3. 4 inches to 6 inches: Valves for heating shall be globe valves modulating electrically actuated, 2-way or 3-way as required, with a rangeability of 50 to 1. Valve body shall be flanged and shall be equipped with a handwheel, or manual position dial mounted adjacent to the valve, to allow manual positioning of the valve in the absence of control power. Valves for cooling shall be butterfly with a rangeability of 25 to 1.
 4. Butterfly Valves: 2-way and 3-way butterfly valves shall be cast iron valve body, with stainless steel stem, and available with disc seal for bubble-tight shut off.
 5. Steam Valves: Valves shall have an ANSI Class 250 lb. body, teflon v-ring packing rated to 377°F., stainless steel trim rated to 50 psi, with rangeability greater than 100:1, Class 4 leakage and close off rating, linear flow characteristics, via perforated throttling cylinder.
- J. Damper Actuators
1. Actuators shall be of the push-pull or rotary type of modulating, 3-point floating, or 2-position control as required by the application. The actuator shall use an overload-proof synchronous motor or an electric motor with end switches to de-energize the motor at the end of the stroke limits. Control voltage shall be 24 VAC, 0-20 VDC, or 4-20 ma as required. Actuators shall be available with spring return to the normal position when required. Actuators shall have a position indicator for external indication of damper position. Actuators shall have manual override capability without disconnecting damper linkage.
- K. Control Dampers
1. Motorized dampers, unless otherwise specified elsewhere, shall have damper frames using 13 gauge galvanized steel channel or $\frac{1}{8}$ " extruded aluminum with reinforced corner bracing. Damper blades shall not exceed ten (10) inches in width or 48" in length. Blades are to be suitable for high velocity performance.

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Damper bearings shall be as recommended by manufacturer for application. Bushings that turn in the bearing are to be oil impregnated sintered metal. All blade edges and top and bottom of the frame shall be provided with replaceable, butyl rubber or neoprene seals. Side seals may be spring-loaded stainless steel. The seals shall provide a maximum of 1% leakage at a wide open face velocity of 1500 FPM and 4: W.C. close-off pressure. The damper linkage shall provide a linear flow or equal percentage characteristic as required. Provide Ruskin RCD46 model or equal.

2. Control dampers shall be parallel or opposed blade type as scheduled on drawings or outdoor and return air mixing box dampers shall be parallel blade, arranged to direct air streams towards each other. All other dampers may be parallel or opposed blade types.

2.12 LEVEL CONTROLLERS

- A. Level controllers shall be Ultrasonic type that have the range of 6" to 24 feet. Accuracy shall be .25% of the span and resolution shall be 1/8". They shall be rated for fluid temperature of -40 to +140 degrees F. The enclosure rating shall be NEMA 4X and shall be mounted on 2" NPT piping connection. They shall be temperature compensated over the above specified range. They shall be provided with a remote indicator to indicate the fluid level in feet and shall include remote relay pack for four levels of control: low level pump cutoff, low level warning, fill, and high level alarm. Remote readout shall include five-digit ID display with engineering units programmed to match the level of fluid being measured along with 11-point linearization function for display and actual tank volume in gallons, thousands of gallons, or percentage as directed by the Engineer. Remote meters shall also be manufactured by Flowline to be compatible with the Ultrasonic level transmitter. Controllers shall be Flowline Model LU30-70-0-3. Remote indication shall be Flowline model L112-1001.

2.13 PERSONAL COMPUTER OPERATOR WORKSTATION HARDWARE:

- A. Personal computer operator workstations shall be provided for command entry, information management, network alarm management and database management functions. All real-time control functions shall be resident in the DDC controllers to facilitate greater fault tolerance and reliability.
 1. Provide a workstation in the MIS (Main Computer Room). Confirm this location before installation.
 2. Workstations shall consist of an SVGA 19" flat screen color monitor, personal computer with minimum 2 Gigabyte RAM, 100 GB hard drive, 48 speed DVD/RW, 3-1/2" diskette drive, mouse and 101-key enhanced keyboard. Personal computer shall be an IBM Compatible PC and shall include a minimum P4/3.1 MHZ processor.
- B. Provide an Epson FX-870 or equivalent printer at the workstation's location for recording alarms, operator transactions, and systems reports.

PART 3 - EXECUTION

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3.1 PROJECT MANAGEMENT

- A. Provide a project manager who shall, as a part of his duties, be responsible for the following activities:
 - 1. Coordination between the Controls Contractor and all other trades, Owner, local authorities and the design team.
 - 2. Scheduling of manpower, material delivery, equipment installation and checkout.
 - 3. Maintenance of construction records such as project scheduling and manpower planning and AutoCAD or Visio for project co-ordination and as-built drawings.
 - 4. Coordination/Single point of contact

3.2 INSTALLATION METHODS

- A. Install systems and materials in accordance with manufacturer's instructions, rough-in drawings and equipment details. Install electrical components and use electrical products complying with requirements of applicable Division-16 sections of these specifications.
- B. The term "control wiring" is defined to include providing of wire, conduit, and miscellaneous materials as required for mounting and connecting electric or electronic control devices.
- C. To run BACnet on the ethernet network, the installer is required to run, at minimum, plenum rated CAT 5e cabling for all runs associated with this network.
- D. All exposed wiring, low and line voltage subject to mechanical damage, shall be run in conduit. Line and low voltage wiring shall be run in separate conduits. Concealed but accessible wiring, except in mechanical rooms and areas where other conduit and piping are exposed shall run in UL plenum rated cable as approved by local codes unless expressly restricted by requirements in Division 16 specification.
- E. All Controllers, Relays, Transducers, etc., required for stand-alone control shall be housed in a NEMA 1 enclosure with a lockable door.

3.3 SYSTEM ACCEPTANCE

- A. General: The system installation shall be complete and tested for proper operation prior to acceptance testing for the Owner's authorized representative. A letter shall be submitted to the Architect requesting system acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing will commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Owner's representative, the system will be accepted. The warranty period will start at this time.

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- B. Field Equipment Test Procedures: DDC control panels shall be demonstrated via a functional end to end test. Such that:
 - 1. All output channels shall be commanded (on/off, stop/start, adjust, etc.) and their operation verified.
 - 2. All analog input channels shall be verified for proper operation.
 - 3. All digital input channels shall be verified by changing the state of the field device and observing the appropriate change of displayed value.
 - 4. If a point should fail testing, perform necessary repair action and retest failed point and all interlocked points.
 - 5. Automatic control operation shall be verified by introducing an error into the system and observing the proper corrective system response.
 - 6. Selected time and setpoint schedules shall be verified by changing the schedule and observing the correct response on the controlled outputs.
 - C. As-Built Documentation: After a successful acceptance demonstration, the Contractor shall submit as-built drawings of the completed project for final approval. After receiving final approval, supply "6" complete as-built drawing sets, together with AutoCAD or Visio diskettes to the owner.
 - D. Operation and Maintenance Manuals: Submit four copies of operation and maintenance manuals. Include the following
 - 1. Manufacturer's catalog data and specifications on sensors, transmitters, controllers, control valves, damper actuators, gauges, indicators, terminals, and any miscellaneous components used in the system.
 - 2. An operator's manual that will include detailed instructions for all operations of the system.
 - 3. An operator's reference table listing the addresses of all connected input points and output points. Settings shall be shown where applicable.
 - 4. A copy of the warranty/guarantee.
 - 5. Operating and maintenance cautions and instructions.
- 3.4 TRAINING
- A. Contractor shall provide to the engineer a training class outline prior to any scheduled training.
 - B. Factory trained control engineers and technicians shall provide training sessions for the Owner's personnel.

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- C. The control contractor shall conduct six (6) four-hour training courses for the designated owners personnel in the maintenance and operation of the control system. One class shall be given before system acceptance and the others monthly into the warranty/guarantee time period.
 - D. The course shall include instruction on specific systems and instructions for operating the installed system to include as a minimum:
 - 1. HVAC system overview
 - 2. Operation of Control System
 - 3. Function of each Component
 - 4. System Operating Procedures
 - 5. Programming Procedures
 - 6. Maintenance Procedures
- 3.5 WARRANTY/GUARANTEE
- A. The control system shall be warranted/guaranteed to be free from defects in both material and workmanship for a period of one (1) year of normal use and service. This warranty/guarantee shall become effective the date the owner accepts or receives beneficial use of the system.
 - B. After completion this contractor shall make adjustments and modification as necessary for the one year warranty period. During this period the contractor as directed by the engineer shall make modifications and adjustments to the building systems at no additional cost or compensation.

END OF SECTION 230900

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SECTION 230993 – SEQUENCES OF OPERATION

PART 1 – SEQUENCE OF OPERATION

All settings specified below are initial settings only and must be field adjusted to satisfy actual jobsite conditions.

- 1.1 EF-1 Restroom Exhaust Fan
 - A. Run Conditions – Scheduled:
 - 1. The fan shall run according to a user definable (adj.) schedule and have a minimum runtime (adj.).
 - B. Exhaust Air Damper:
 - 1. The exhaust air damper shall open anytime the unit runs and shall close anytime the unit stops. The exhaust air damper shall close 30 sec (adj.) after the fan stops.
 - C. Fan Status:
 - 1. The controller shall monitor the fan status.
 - D. Alarms shall be provided as follows:
 - 1. Damper Failure: Commanded open, but the status is closed.
 - 2. Damper in Hand: Commanded closed, but the status is open.
 - 3. Fan Failure: Commanded on, but the status is off.
 - 4. Fan in Hand: Commanded off, but the status is on.
 - 5. Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.).
 - E. EF-1 Control Point Schedule

Point Name	Hardware Points				Software Points						Show On Graphic	
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm		
Fan Status			X							X		X
Exhaust Air Damper				X						X		X
Fan Start/Stop				X						X		X
Schedule								X				
Fan Failure											X	

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Fan in Hand										x	
Fan Runtime Exceeded										x	
Totals	0	0	1	2	0	0	0	1	3	3	3
Total Hardware (3)					Total Software (7)						

- 1.2 EF-2 Kitchen Hood Exhaust Fan
- A. Run Conditions – Interlocked:
 - 1. The fan EF-2 shall be interlocked to run whenever the Kitchen Hood runs, unless shutdown on safeties.
 - B. Fan:
 - 1. The fan shall have a user definable (adj.) minimum runtime.
 - C. Fan Status:
 - 1. The controller shall monitor the fan status.
 - D. Alarms shall be provided as follows:
 - 1. Fan Failure: Commanded on, but the status is off.
 - 2. Fan in Hand: Commanded off, but the status is on.
 - 3. Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.).
 - E. EF-2 Control Point Schedule

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Fan Status			x						x		x
Fan Start/Stop				x					x		x
Fan Failure										x	
Fan in Hand										x	
Fan Runtime Exceeded										x	
Totals	0	0	1	1	0	0	0	0	2	3	2
Total Hardware (2)					Total Software (5)						

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1.3 EF-3 Pizza Oven Exhaust Fan

- A. Run Conditions - Interlocked:
 - 1. The fan EF-3 shall be interlocked to run whenever the Pizza Oven is in use unless shutdown on safeties.
- B. Fan:
 - 1. The fan shall have a user definable (adj.) minimum runtime.
- C. Fan Status:
 - 1. The controller shall monitor the fan status.
- D. Alarms shall be provided as follows:
 - 1. Fan Failure: Commanded on, but the status is off.
 - 2. Fan in Hand: Commanded off, but the status is on.
 - 3. Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.).
- E. EF-3 Control Point Schedule

Point Name	Hardware Points				Software Points						Show On Graphic	
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm		
Fan Status			x							x		x
Fan Start/Stop				x						x		x
Fan Failure											x	
Fan in Hand											x	
Fan Runtime Exceeded											x	
Totals	0	0	1	1	0	0	0	0	0	2	3	2
Total Hardware (2)					Total Software (5)							

1.4 FC-1 Fan Coil Unit:

- A. Run Conditions - Continuous:
 - 1. The unit shall run continuously and shall maintain:
 - a. A 75°F (adj.) cooling setpoint

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- B. Zone Setpoint Adjust:
 - 1. The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.
- C. Fan:
 - 1. The fan shall run anytime the unit is commanded to run unless shutdown on safeties.
- D. Cooling Coil Valve:
 - 1. The controller shall measure the zone temperature and modulate the cooling coil valve to maintain its cooling setpoint.
 - 2. The cooling shall be enabled whenever:
 - a. The zone temperature is above cooling setpoint.
 - b. AND the fan is on.
- E. Fan Status:
 - 1. The controller shall monitor the fan status.
- F. Alarms shall be provided as follows:
 - 1. High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
 - 2. Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).
 - 3. Fan Failure: Commanded on, but the status is off.
 - 4. Fan in Hand: Commanded off, but the status is on.
 - 5. Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.).
- G. FC-1 Control Point Schedule

Point Name	Hardware Points				Software Points						Show On Graphic	
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm		
Zone Setpoint Adjust	x											x
Zone Temp	x								x			x

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Cooling Valve		x							x		x
Fan Status			x								x
Fan Start/Stop				x					x		x
Cooling Setpoint					x				x		x
Schedule								x			
Fan Failure										x	
Fan in Hand										x	
Fan Runtime Exceeded										x	
High Zone Temp										x	
Low Zone Temp										x	
Totals	2	1	1	1	1	0	0	1	4	5	6
Total Hardware (5)					Total Software (11)						

- 1.5 Radiant Heating (typical of 9, Horizontal Panel, Ceiling Panel, and Finned Tube)
- A. Run Conditions - Scheduled:
 - 1. The units shall run according to a user definable time schedule in the following modes:
 - a. Occupied Mode: The Unit shall maintain a heating setpoint of 70 degF (adj.).
 - b. Unoccupied Mode: The Unit shall maintain a heating setpoint of 65 degF (adj.).
 - B. Heating Coil Valve:
 - 1. The controller shall measure the zone temperature and modulate the heating coil valve to maintain its heating setpoint.
 - 2. The heating shall be enabled whenever:
 - a. Outside air temperature is less than 65 degF (adj.).
 - b. AND the zone temperature is below the heating setpoint.
 - C. Alarms shall be provided as follows:
 - 1. Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

D. Radiant Heating Control Point Schedule

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Zone Temp	x								x		x
Heating Valve		x							x		x
Heating Setpoint					x				x		x
Low Zone Temp										x	
Totals	1	1	0	0	1	0	0	0	3	1	3
Total Hardware (2)					Total Software (5)						

1.6 P-3, P-4 Hot Water Pump

- A. Hot Water Pump Run Conditions:
 - 1. The hot water pump shall be enabled whenever:
 - a. A definable number of hot water coils need heating.
 - b. AND outside air temperature is less than 54°F (adj.).
- B. Freeze Protection:
 - 1. The pump shall run for freeze protection anytime outside air temperature is less than 38°F (adj.).
- C. Hot Water Differential Pressure Control:
 - 1. The controller shall measure hot water differential pressure and modulate the hot water pump VFD to maintain its hot water differential pressure setpoint.
- D. Short Cycling:
 - 1. To prevent short cycling, the pump shall run for a minimum time and be off for a minimum time (both user adjustable).
- E. Hot Water Differential Pressure Control:
 - 1. The controller shall measure hot water differential pressure and modulate the hot water pump VFD to maintain its hot water differential pressure setpoint.
 - a. The controller shall modulate hot water pump speeds to maintain a hot water differential pressure of 12 psi (adj.). The VFD's minimum speed shall not drop below 20% (adj.).

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- b. On dropping hot water differential pressure, the VFD shall increase output to maintain setpoint.
- c. On rising hot water differential pressure, the VFD shall decrease output to maintain setpoint.
- F. Alarms shall be provided as follows:
 - 1. Pump Failure: Commanded on, but the status is off.
 - 2. Pump Running in Hand: Commanded off, but the status is on.
 - 3. Pump Runtime Exceeded: Status runtime exceeds a user definable limit.
 - 4. VFD Fault.
 - 5. High Hot Water Differential Pressure: If 25% (adj.) greater than setpoint.
 - 6. Low Hot Water Differential Pressure: If 25% (adj.) less than setpoint.
- G. Hot Water Pump Control Point Schedule

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Differential Pressure	x								x		x
VFD Speed		x							x		x
Pump Status			x						x		x
VFD Fault			x							x	x
Pump Start/Stop				x					x		x
Differential Pressure Setpoint					x						x
Outside Air Temp					x						x
High Differential Pressure										x	
Pump Failure										x	
Pump Running in Hand										x	
Pump Runtime Exceeded										x	
Low Differential Pressure										x	
Totals	1	1	2	1	2	0	0	0	4	6	7

Total Hardware (5)	Total Software (12)
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- 1.7 AHU-1 Variable Volume Rooftop Unit
- A. Run Conditions – Requested:
 - 1. The unit shall run whenever:
 - a. Any zone is occupied.
 - b. OR a definable number of unoccupied zones need heating or cooling.
 - B. Emergency Shutdown:
 - 1. The unit shall shut down and generate an alarm upon receiving an emergency shutdown signal.
 - C. Freeze Protection:
 - 1. The unit shall shut down and generate an alarm upon receiving a freezestat status.
 - D. Supply Air Smoke Detection:
 - 1. The unit shall shut down and generate an alarm upon receiving a supply air smoke detector status.
 - E. Supply Fan:
 - 1. The supply fan shall run anytime the unit is commanded to run unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.
 - F. Supply Air Duct Static Pressure Control:
 - 1. The controller shall measure duct static pressure and modulate the supply fan VFD speed to maintain a duct static pressure setpoint. The speed shall not drop below 30% (adj.). The static pressure setpoint shall be reset based upon the position of the zone dampers, with a goal of reducing the static pressure until at least one zone damper is nearly wide open.
 - a. The initial duct static pressure setpoint shall be 1.5in H2O (adj.).
 - b. If no zone damper is nearly the fully open position, the setpoint shall incrementally reset down to a minimum of 1.3in H2O (adj.).
 - c. As one or more dampers nears the fully open position, the setpoint shall incrementally reset up to a maximum of 1.8in H2O (adj.).
 - G. Return Fan:
 - 1. The return fan shall run whenever the supply fan runs.

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- H. Return Plenum Static Pressure Control
 - 1. The controller shall measure return plenum static pressure and modulate the return fan VFD speed to maintain a return plenum static pressure setpoint of 0.2in H₂O (adj.). The return fan VFD speed shall not drop below 20% (adj.).
- I. Supply Air Temperature Setpoint - Outside Air Reset:
 - 1. The controller shall monitor the supply air temperature and shall maintain a supply air temperature setpoint reset based on outside air temperature.
 - 2. The supply air temperature setpoint shall reset for cooling as follows:
 - a. As outside air temperature rises from 50°F (adj.) to 85°F (adj.) the supply air temperature setpoint shall reset downwards from 65°F (adj.) to 55°F (adj.).
 - 3. If the return air temperature drops below 68°F (adj.), then the supply air temperature setpoint shall be reset for heating as follows:
 - a. As outside air temperature drops from 50°F (adj.) to 20°F (adj.), the supply air temperature setpoint shall reset upwards from 75°F (adj.) to 95°F (adj.).
- J. Cooling Stages:
 - 1. The controller shall measure the supply air temperature and stage the cooling to maintain its cooling setpoint. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.
 - 2. The cooling shall be enabled whenever:
 - a. Outside air temperature is greater than 60°F (adj.).
 - b. AND the economizer is disabled or fully open.
 - c. AND the supply fan status is on.
 - d. AND the heating is not active.
- K. Gas Heating Stages:
 - 1. The controller shall measure the supply air temperature and stage the heating to maintain its heating setpoint. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.
 - 2. The heating shall be enabled whenever:
 - a. Outside air temperature is less than 65°F (adj.).
 - b. AND the supply fan status is on.
 - c. AND the cooling is not active.

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3. The heating stages shall run for freeze protection whenever:
 - a. Supply air temperature drops from 40°F to 35°F (adj.).
 - b. AND the supply fan status is on.
- L. Economizer:
 1. The controller shall measure the mixed air temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F (adj.) less than the supply air temperature setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open whenever occupied.
 2. The economizer shall be enabled whenever:
 - a. Outside air temperature is less than 65°F (adj.).
 - b. AND the outside air temperature is less than the return air temperature.
 - c. AND the supply fan status is on.
 3. The economizer shall close whenever:
 - a. Mixed air temperature drops from 40°F to 35°F (adj.).
 - b. OR the freezestat (if present) is on.
 - c. OR on loss of supply fan status.
 4. The outside and exhaust air dampers shall close, and the return air damper shall open when the unit is off. If Optimal Start Up is available, the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.
- M. Minimum Outside Air Ventilation - Carbon Dioxide (CO₂) Control:
 1. When in the occupied mode, the controller shall measure the return air CO₂ concentration and modulate the outside air dampers open on rising CO₂ concentrations, overriding normal damper operation to maintain a CO₂ setpoint of 750 ppm (adj.).
- N. Prefilter Differential Pressure Monitor:
 1. The controller shall monitor the differential pressure across the prefilter.
- O. Mixed Air Temperature:
 1. The controller shall monitor the mixed air temperature and use as required for economizer control (if present) or preheating control (if present).
- P. Return Air Carbon Dioxide (CO₂) Concentration Monitoring:
 1. The controller shall measure the return air CO₂ concentration.

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- Q. Return Air Temperature:
 - 1. The controller shall monitor the return air temperature and use as required for setpoint control or economizer control (if present).
- R. Supply Air Temperature:
 - 1. The controller shall monitor the supply air temperature.
- S. Alarms shall be provided as follows:
 - 1. Supply Fan Failure: Commanded on, but the status is off.
 - 2. Supply Fan in Hand: Commanded off, but the status is on.
 - 3. Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).
 - 4. High Supply Air Static Pressure: If the supply air static pressure is 25% (adj.) greater than setpoint.
 - 5. Low Supply Air Static Pressure: If the supply air static pressure is 25% (adj.) less than setpoint.
 - 6. Supply Fan VFD Fault.
 - 7. Return Fan Failure: Commanded on, but the status is off.
 - 8. Return Fan in Hand: Commanded off, but the status is on.
 - 9. Return Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).
 - 10. Return Fan VFD Fault.
 - 11. High Return Plenum Static Pressure: If the return air plenum static pressure is 25% (adj.) greater than setpoint.
 - 12. Low Return Plenum Static Pressure: If the return air plenum static pressure is 25% (adj.) less than setpoint.
 - 13. High Supply Air Temp: If the supply air temperature is 5°F (adj.) greater than setpoint.
 - 14. Low Supply Air Temp: If the supply air temperature is 5°F (adj.) less than setpoint.
 - 15. Prefilter Change Required: Prefilter differential pressure exceeds a user definable limit (adj.).
 - 16. High Mixed Air Temp: If the mixed air temperature is greater than 90°F (adj.).
 - 17. Low Mixed Air Temp: If the mixed air temperature is less than 45°F (adj.).

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- 18. High Return Air Carbon Dioxide Concentration: If the return air CO2 concentration is greater than 1000ppm (adj.) when in the unit is running.
- 19. High Return Air Temp: If the return air temperature is greater than 90°F (adj.).
- 20. Low Return Air Temp: If the return air temperature is less than 45°F (adj.).
- 21. High Supply Air Temp: If the supply air temperature is greater than 120°F (adj.).
- 22. Low Supply Air Temp: If the supply air temperature is less than 45°F (adj.).

T. AHU-1 Points List

	Hardware Points				Software Points							
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic	
Mixed Air Temp	x								x		x	
Prefilter Differential Pressure	x								x			
Return Air Carbon Dioxide PPM	x								x		x	
Return Air Temp	x								x		x	
Return Plenum Static Pressure	x								x		x	
Supply Air Static Pressure	x								x	x	x	
Supply Air Temp	x								x		x	
Mixed Air Dampers		x							x		x	
Return Fan VFD Speed		x							x		x	
Supply Fan VFD Speed		x							x		x	
Freezestat			x						x	x	x	
Return Fan Status			x						x		x	
Return Fan VFD Fault			x							x	x	
	Hardware Points				Software Points							
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show on Graphic	
Supply Air Smoke Detector			x						x	x	x	

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Supply Fan Status			x							x		x
Supply Fan VFD Fault			x								x	x
Cooling Stage 1				x						x		x
Cooling Stage 2				x						x		x
Heating Stage 1				x						x		x
Heating Stage 2				x						x		x
Heating Stage 3				x						x		x
Heating Stage 4				x						x		x
Return Fan Start/Stop				x						x		x
Supply Fan Start/Stop				x						x		x
Economizer Mixed Air Temp Setpoint					x					x		x
Outside Air Temp					x							x
Return Air Carbon Dioxide PPM Setpoint					x					x		x
Return Plenum Static Pressure Setpoint					x					x		x
Supply Air Static Pressure Setpoint					x					x		x
Supply Air Temp Setpoint					x					x		x
Emergency Shutdown						x				x	x	x
Compressor Runtime Exceeded											x	
High Mixed Air Temp											x	
	Hardware Points				Software Points							
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show on Graphic	
High Return Air Carbon Dioxide Concentration										x		

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High Return Air Temp											x	
High Return Plenum Static Pressure											x	
High Supply Air Static Pressure											x	
High Supply Air Temp											x	
High Supply Air Temp											x	
Low Mixed Air Temp											x	
Low Return Air Temp											x	
Low Return Plenum Static Pressure											x	
Low Supply Air Static Pressure											x	
Low Supply Air Temp											x	
Low Supply Air Temp											x	
Prefilter Change Required											x	x
Return Fan Failure											x	
Return Fan in Hand											x	
Return Fan Runtime Exceeded											x	
Supply Fan Failure											x	
Supply Fan in Hand											x	
Supply Fan Runtime Exceeded											x	
Totals	7	3	6	8	6	1	0	0	28	27	31	
Total Hardware (24)					Total Software (62)							

- 1.8 VR- VAV Boxes (typical of all VAV boxes EXCEPT VR401A)
- A. Run Conditions – Scheduled:
 - 1. The unit shall run according to a user definable time schedule in the following modes:
 - a. Occupied Mode: The unit shall maintain a heating setpoint of 70°F (adj.).

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- b. Unoccupied Mode (night setback): The unit shall maintain a heating setpoint of 55°F (adj.).
 - 2. Zone Setpoint Adjust:
 - a. The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.
- B. Reheating Coil Valve:
 - 1. The controller shall measure the zone temperature and modulate the reheating coil valve to maintain its setpoint.
 - 2. The reheating shall be enabled whenever:
 - a. Outside air temperature is less than 65°F(adj.).
 - b. AND the zone temperature is below setpoint.
 - c. AND sufficient airflow is provided.
- C. Alarms shall be provided as follows:
 - 1. Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Zone Setpoint Adjust	x										x
Zone Temp	x								x		x
Reheating Valve		x							x		x
Heating Setpoint					x				x		x
Schedule								x			
Low Zone Temp										x	
Totals	2	1	0	0	1	0	0	1	3	1	4

1.9 Veranda 401A

A. Operable Windows:

- 1. Veranda 401A contains large operable windows on the East wall that open to the outdoors. Provide a dry contact switch on each window.

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- a. When the windows are open:
 - 1) The damper in the VAV box 401A shall close,
 - 2) AND The control valve for the heating coil in VAV box 401A shall close (or bypass if applicable)
 - 3) AND the radiant heating (RP-401A.1 and RP-401A.2) shall be disabled.
- b. When the windows are closed:
 - 1) VR-401A shall operate as described in Section 1.8
 - 2) RP-401A.1 and RP-401A.2 shall operate as described in Section 1.5
- B. Alarms shall be provided as follows:
 - 1. Low Zone Temp: The windows are open, and the zone temperature is lower than 50 degF (adj.).

END OF SECTION 230993

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
 - 1. Hot-water heating piping.
 - 2. Air-vent piping.
 - 3. Dielectric fittings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Steel pipe and fittings.
 - 2. Copper pipe, tubing and fittings.
 - 3. Dielectric fittings.
- B. 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: 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:

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1. Suspended ceiling components.
2. Other building services.
3. Structural members.

B. Qualification Data: For Installer.

C. Welding certificates.

D. Field quality-control reports: Written reports as specified in Part 3 of this section including:

1. Test procedures used.
2. Test results showing compliance with specified requirements.
3. Failed test results with corrective action taken to achieve compliance with specified requirements.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.6 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

D. Coordinate pipe fitting pressure classes with products specified in related sections.

E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

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- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Through-Penetration Firestop Systems" for fire and smoke wall and floor assemblies.

1.7 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Forged Steel "Olet" Type Fittings, Welding, Socket-Welding and Threaded: ASME B16.11 and ASTM A105.

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1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc. Capitol Manufacturing Co.
 - c. Capitol Manufacturing Company.
 - d. Central Plastics Company.
 - e. Elster Perfection.
 - f. Grinnell Mechanical Products.
 - g. Matco-Norca.
 - h. Pipeline Seal and Insulator, Inc.
 - i. Precision Plumbing Products, Inc.
 - j. Victaulic Company.
 - k. Watts Regulator Co.
 - l. Zurn Industries, LLC.

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- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. **End Connections:** Threaded, or flanged.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and **300-psig** minimum working pressure at **225 deg F**.
- F. Dielectric Nipples or Waterways: Electroplated steel with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and **300-psig** minimum working pressure at **225 deg F**.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller shall be **[any of]** the following:
 - 1. **Type L** drawn-temper copper tubing, wrought-copper fittings, and **soldered** joints.
 - 2. **Schedule 40**, Grade B, Type 96 steel pipe; **Class 125, cast-iron** fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be **[any of]** the following:
 - 1. **Type L**, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. **Schedule 40** steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- C. Air-Vent Piping:
 - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
 - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- D. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

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3.2 PIPING INSTALLATIONS

A. PRE-WORK / PRE-REQUISITES

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
2. The Contractor shall study the architectural, structural, mechanical, electrical and other drawings to eliminate conflict of piping with other structure lighting or other services.

B. CONDITION

1. All installed pipelines shall be free from dents, scars, and burrs, with ends reamed smooth.
2. All piping shall be clean and free from acids and loose dirt when installed and shall be kept clean during the completion of the installation.
3. Install piping free of sags and bends.
4. All installed pipe lines shall remain straight against strains tending to cause distortion during system operation. The contractor shall make proper allowance for pipe line expansion and contraction so that no unsightly distortion, noise, damage or improper operation results therefrom.

C. SELECTION

1. Select system components with pressure rating equal to or greater than system operating pressure.
2. No street type fittings shall be used.
3. No short nipples shall be used except at drain valves.
4. Plugs of rags, wools, cottons, waste, or similar materials may not be used for plugging.

D. ROUTING/ARRANGEMENT

1. Piping installations shall be neatly organized.
2. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
3. Install groups of pipes parallel to each other.
4. Install piping spaced to permit application of insulation.
5. Install piping parallel and spaced to permit the servicing of valves.

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6. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls or axis of the building.
7. Diagonal runs are prohibited unless specifically indicated otherwise.
8. Install fittings for all changes in direction.
9. No piping shall be run above any electrical panels, electrical equipment or access clearances for electrical for electrical panels or equipment. No piping shall be allowed to run through any electrical rooms.
10. Piping shall be arranged, placed and installed to facilitate equipment maintenance and shall be so arranged to not interfere with the installation of the air-conditioning equipment, ducts, or the removal of other equipment or devices. All specialties shall be so placed to permit easy operation and access.
11. All piping shall be so installed to insure noiseless circulation.
12. Install fittings for all branch connections.
13. Unless otherwise indicated, install branch connections to mains with tee fittings or forged steel branch fittings in main pipe, with the branch connected to the bottom of the main pipe.
14. For up-feed risers, connect the branch to the top of the main pipe.
15. Forged branch fittings shall be installed per the manufacturer's recommendations.

E. ACCESS / ARRANGEMENT

1. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal. All piping shall be so arranged to not block access to manholes, access openings, etc.
2. Install piping at indicated slopes. If not indicated, install piping at a uniform grade of 0.2 percent where possible, upward in direction of flow. Traps are to be avoided where-ever possible.
3. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
4. When insulated pipes are supported by a roller hanger they shall be protected from damage by suitable pipe covering protection saddles. Saddles shall support pipe on roller and shall be packed with insulation.
5. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."
6. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, at each coil on all sides of automatic valves where valves do not have union connections, elsewhere as indicated, and wherever necessary to prevent undue difficulty in making repairs or replacement. Unions are not required at flanged connections.

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7. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated. Install flanges on valves, apparatus, and equipment having 2 ½ inch NPS and larger connections. Flanges or unions as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment.
8. Install shutoff valve immediately upstream of each dielectric fitting. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
9. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides. Anchor piping for proper direction of expansion and contraction.
10. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
11. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
12. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."
13. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS ¾) nipple and ball valve in blow-down connection of strainers NPS 2) and larger. Match size of strainer blow-off connection for strainers smaller than NPS 2).
14. Install flexible connectors at inlet and discharge connections to pumps (except inline pumps) and other vibration-producing equipment.

F. DRAINAGE

1. Drain valves shall be installed at all low points in all piping systems to allow for complete drainage of piping systems.
2. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
3. All piping systems shall be installed so that they can be easily drained by means of drainage of low points of all piping without disconnecting pipe.
4. If not specifically indicated on the drawings, the frequency of draining shall determine whether drain caps, plugs, cocks, or valves are to be used.

G. IDENTIFICATION

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1. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

3.3 DIELECTRIC FITTING INSTALLATION

A. Make connections according to the following, unless otherwise indicated:

1. **Install dielectric nipples or waterways** in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install **waterways**, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install Dielectric Fittings into Hydronic Piping Systems: Install dielectric nipples, waterways or couplings to connect piping materials of dissimilar metals.
4. **End Connections: Threaded or flanged.**

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Steel roof deck shall not be used to support loads from piping, ductwork or equipment, unless noted otherwise. Hanger loads less than 50 lbs. may be hung from the steel roof deck in cases when hanging from the steel roof deck cannot be avoided; the attachment method must distribute the load across the deck as approved by the Structural Engineer.
- D. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 4. Spring hangers to support vertical runs.
 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

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6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- E. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 2. NPS 1: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 1/2 inch.
 6. NPS 3 and Larger: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- F. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- G. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- H. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.
- I. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

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- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.

3.7 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. 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.

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5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

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SECTION 232116 - HYDRONIC PIPING SPECIALTIES

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 special-duty valves and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Makeup-water piping.
 - 3. Condensate-drain piping.
 - 4. Air-vent piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air-control devices.
 - 3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

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1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.6 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 VALVES

- A. **Globe, Check, Ball, and Butterfly Valves:** Comply with requirements specified in Section 230523 "General-Duty Valves for HVAC Piping. Gate valves are not allowed on this project.
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230900 "Instrumentation and Control for HVAC.
- C. Refer to Part 3 "Valve Applications" Article for applications of each valve.
- D. Bronze, Calibrated-Orifice or Venturi, Balancing Valves, NPS 2 and smaller:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Taco.
 - g. Tour & Andersson; available through Victaulic Company.
 - h. Nexus Valve, Inc.
 - i. NIBCO, Inc. (S/T/PC-1910 or S/T/PC-1805)
 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 3. Ball: Brass or stainless steel.
 4. Plug: Resin.
 5. Seat: PTFE.
 6. End Connections: Threaded or socket.

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7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 8. Handle Style: Lever, with memory stop to retain set position.
 9. CWP Rating: Minimum **125 psig**.
 10. Maximum Operating Temperature: **250 deg F**.
- E. Cast-Iron or Steel, Calibrated-Orifice or Venturi, Balancing Valves, NPS 2 ½ and larger:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Flow Design Inc.
 - e. Gerand Engineering Co.
 - f. Grinnell.
 - g. Griswold Controls.
 - h. Taco.
 - i. Tour & Andersson; available through Victaulic Company.
 - j. Spence Engineering Company Inc.
 - k. Watts Regulator Co.
 - l. Nexus Valve, Inc.
 - m. NIBCO, Inc. (F-737 OR F-739)
 2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
 3. Ball: Brass or stainless steel.
 4. Stem Seals: EPDM O-rings.
 5. Disc: Glass and carbon-filled PTFE.
 6. Seat: PTFE.
 7. End Connections: Flanged or grooved.
 8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 9. Handle Style: Lever, with memory stop to retain set position.
 10. CWP Rating: Minimum **125 psig**.
 11. Maximum Operating Temperature: **250 deg F**.

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F. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: **Brass**, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Conbraco Industries, Inc.
 - e. Kunkle.
 - f. Spence Engineering Company, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.

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7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: **Brass**, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

H. Automatic Flow-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Flow Design Inc.
 - d. Griswold Controls.
 - e. Taco
 - f. Nexus Valve, Inc.
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Tamper proof, self-cleaning, and removable, for inspections and replacement.
 - a. **Corrosion resistant.**
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Attached by chain and marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations:
 - a. **Minimum CWP Rating: 175 psig.**
8. **Maximum Operating Temperature: 200 deg F.**
9. Fitted with pressure and temperature test valves.
10. Equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case.

2.2 AIR-CONTROL DEVICES

A. Manual Air Vents:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc
 2. Body: Bronze.
 3. Internal Parts: Nonferrous.
 4. Operator: Screwdriver or thumbscrew.
 5. Manually operated with ball valve in the down position.
 6. Inlet Connection: **NPS 1/2.**
 7. Discharge Connection: **NPS 1/8.**
 8. CWP Rating: **150 psig.**
 9. Maximum Operating Temperature: **225 deg F.**
- B. Automatic Air Vents:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Hoffman Specialty ITT; Fluid Handling Div.
 - d. Spirax-Sarco.
 - e. Spirovent.
 - f. Taco, Inc.
 - g. Honeywell-Baukman.
 2. Body: Bronze or cast iron.
 3. Internal Parts: Nonferrous.
 4. Operator: Noncorrosive metal float.
 5. Inlet Connection: **NPS 1/2.**
 6. Discharge Connection: **NPS 1/4.**
 7. CWP Rating: **150 psig.**
 8. Maximum Operating Temperature: **240 deg F.**

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2.3 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Machine Works.
 - b. Hoffman Specialty ITT; Fluid Handling Div.
 - c. Metraflex Co.
 - d. Mueller
 - e. Spirax Sarco.
 - f. Trane Co.
 - g. Tour & Andersson; available through Victaulic Company.
 - h. Watts Regulator Co.
 - i. Nexus Valve
2. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for **NPS 2** and smaller; flanged ends for **NPS 2-1/2** and larger.
4. Strainer Screen: Stainless-steel, or perforated stainless-steel basket:
 - a. **20**-mesh strainer.
5. CWP Rating: **125 psig**.

B. Basket Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Metraflex Co.
 - c. Mueller
 - d. Spirax Sarco.
 - e. Tour & Andersson; available through Victaulic Company.
2. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for **NPS 2** and smaller; flanged ends for **NPS 2-1/2** and larger.
4. Strainer Screen: Perforated stainless-steel basket with 50 percent free area:
 - a. **40-mesh startup strainer**.
5. CWP Rating: **125 psig**.

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C. Spherical, Rubber, Flexible Connectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amber-Booth.
 - b. Mason Industries.
 - c. Metraflex Co.
 - d. Flex-Weld.
 - e. Fugate.
 - f. Twin City Hose.
 - g. Nexus Valve, Inc.
2. Body: Double-sphere fiber-reinforced EPDM rubber body.
3. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
4. Performance: Capable of misalignment.
5. CWP Rating: **150 psig**.
6. Maximum Operating Temperature: **250 deg F**.

D. Diverting Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
2. Body: Cast Iron or Wrought Copper
3. Ends: Threaded or Soldered
4. Flow Direction: Indicated on fitting.
5. CWP Rating: **125 psig**.
6. Maximum Operating Temperature: **250 deg F**.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

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- B. **Install calibrated-orifice**, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Automatic air vents may cause damage to ceilings and other finished surfaces. Air vents aid in system filling. Air removal after initial startup is accomplished by air separator or boiler diptube. Manual air vents may be a better solution.
- C. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

END OF SECTION 232116

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SECTION 233001 - COMMON DUCT REQUIREMENTS

PART 1 - PRODUCTS

1.1 SUMMARY

A. Includes But Not Limited To:

1. General procedures and requirements for ductwork.
2. Repair leaks in ductwork, as identified by smoke test, at no additional cost to Owner.
3. Soundproofing procedures for duct penetrations of walls, ceilings, and floors in mechanical equipment rooms.

B. Related Sections:

1. Division 07: Quality of Acoustic Sealant.
2. Section 23 0500: Common Work Results for HVAC
3. Section 23 0593: Testing Adjusting and Balancing for HVAC.

1.2 SUBMITTALS

A. Samples: Sealer and gauze proposed for sealing ductwork.

B. Quality Assurance / Control:

1. Manufacturer's installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.
2. Specification data on sealer and gauze proposed for sealing ductwork.

1.3 QUALITY ASSURANCE

A. Requirements: Construction details not specifically called out in Contract Documents shall conform to applicable requirements of SMACNA HVAC Duct Construction Standards.

B. Pre-Installation Conference: Schedule conference immediately before installation of ductwork.

1.4 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 Finishes, Where Applicable: Colors as selected by Architect.

2.2 Duct Hangers:

- A. One inch by **18 ga** galvanized steel straps or steel rods as shown on Drawings, and spaced not more than **96 inches** apart. Do not use wire hangers.
 - 1. Attaching screws at trusses shall be **2 inch** No. 10 round head wood screws. Nails not allowed.
 - 2. Attach threaded rod to steel joist with Grinnell Steel washer plate Fig. 60 - ph-1. Double nut connection.

2.3 Penetration Soundproofing Materials:

- A. Insulation for Packing: Fiberglass.
- B. Calking: Polysulphide.
- C. Escutcheon Frame: **22 ga** galvanized iron **2 inches** wide.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.
- B. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.
- C. Hangers And Supports:
 - 1. Install pair of hangers close to each transverse joint and elsewhere as required by spacing indicated in table on Drawings.

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2. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
3. Attach strap hangers to ducts with cadmium-plated screws. Use of pop rivets or other means will not be accepted.
4. Where hangers are secured to forms before concrete slabs are poured, cut off flush all nails, strap ends, and other projections after forms are removed.
5. Secure vertical ducts passing through floors by extending bracing angles to rest firmly on floors without loose blocking or shimming. Support vertical ducts, which do not pass through floors, by using bands bolted to walls, columns, etc. Size, spacing, and method of attachment to vertical ducts shall be same as specified for hanger bands on horizontal ducts.

D. Penetration Soundproofing

1. Pack space between ducts and structure full of fiberglass insulation of sufficient thickness to be wedged tight, allowing space for application of caulking.
2. Provide caulking at least **2 inches** thick between duct and structure on both ends of opening through structure.
3. Provide metal escutcheon on Equipment Room side. Secure escutcheon to wall.

3.2 CLEANING

- A. Clean interior of duct systems before final completion.

END OF SECTION 233001

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SECTION 233113 - METAL DUCTS

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. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall **round and flat-oval** ducts and fittings.
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
3. Section 230713 "Duct Insulation" for duct insulation and fire wrap.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and **vibration isolation**.
13. Duct fabrication shall not begin until shop drawings have been submitted and reviewed by the mechanical engineer.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. **Design Calculations: Calculations for selecting hangers and supports.**

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1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.
 - 3. Structural members to which duct will be attached.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Penetrations of smoke barriers and fire-rated construction.
 - 6. Items penetrating finished ceiling including, but not limited to the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
- B. Welding certificates.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to [AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.]
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

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- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

1.7 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Duct dimensions shown on drawings are inside clear dimensions.
- E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- B. Duct dimensions shown on drawings are inside clear dimensions.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse

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Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: **0.27 Btu x in./h x sq. ft. x deg F at 75 deg F** mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 - 1. Maximum Thermal Conductivity: **0.25 Btu x in./h x sq. ft. x deg F at 75 deg F** mean temperature.
- H. **Inner Duct:** Minimum **0.028-inch** perforated galvanized sheet steel having **3/32-inch**-diameter perforations, with overall open area of 23 percent. Inner duct shall be solid sheet steel a minimum of 10 feet downstream of humidifiers or air washers.
- I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

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- B. Duct dimensions shown on drawings are inside clear dimensions.
- C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than **60 inches** in Diameter: Flanged.
- E. Longitudinal Seams: Not allowed.
- F. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653.
 - 1. Galvanized Coating Designation: **G90**.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. 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**.

2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 2. Maximum Thermal Conductivity:
 - a. Type I, Flexible: **0.27 Btu x in./h x sq. ft. x deg F at 75 deg F** mean temperature.
 - b. Type II, Rigid: **0.23 Btu x in./h x sq. ft. x deg F at 75 deg F** mean temperature.
 3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 4. Water-Based Liner Adhesive:
 - a. Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - b. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA Inc.
 - b. Armacell LLC.
 - c. Rubatex International, LLC
 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. 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).
- C. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, , length to suit depth of insulation indicated with integral **1-1/2-inch** galvanized carbon-steel washer.

- a. **0.135-inch**-diameter shank.
2. Insulation-Retaining Washers: With beveled edge sized as required to hold insulation securely in place but not less than **1-1/2 inches** in diameter.
 - a. Self-locking washers formed from **0.016-inch-thick aluminum**.
- D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Secure liner with mechanical fasteners **4 inches** from corners and at intervals not exceeding **12 inches** transversely; at **3 inches** from transverse joints and at intervals not exceeding **18 inches** longitudinally.
 7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 8. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: **3/32-inch** diameter, with an overall open area of 23 percent.
 9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated build-outs (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

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2.6 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: **4 inches**.
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: **10-inch wg**, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: **Minus 40 to plus 200 deg F**.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: **10-inch wg**, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

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D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.

8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.

10. Maximum Static-Pressure Class: **10-inch wg**, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of **3 cfm/100 sq. ft. at 1-inch wg** and shall be rated for **10-inch wg** static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

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3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," **Table 5-1**, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install **round and flat-oval** ducts in maximum practical lengths.

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- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of **2 inch**, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least **1-1/2 inches**.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. **Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines" .**

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

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3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. **Outdoor, Exhaust Ducts: Seal Class A.**
 - 4. **Outdoor, Return-Air Ducts: Seal Class A.**
 - 5. **Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class A.**
 - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than **2-Inch wg**: Seal Class A.
 - 7. **Unconditioned Space, Exhaust Ducts: Seal Class A.**
 - 8. **Unconditioned Space, Return-Air Ducts: Seal Class A.**
 - 9. **Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class A.**
 - 10. **Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.**
 - 11. **Conditioned Space, Exhaust Ducts: Seal Class A.**
 - 12. **Conditioned Space, Return-Air Ducts: Seal Class A.**

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

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3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than **4 inches** thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than **4 inches** thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," **Table 5-1**, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within **24 inches** of each elbow and within **48 inches** of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of **16 feet**.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with the requirements specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 1. Comply with **ASCE/SEI 7**.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

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3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:
 - a. Supply Ducts with a Pressure Class of **2-Inch wg** or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - b. Return Ducts with a Pressure Class of **2-Inch wg** or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - c. Exhaust Ducts with a Pressure Class of **2-Inch wg** or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - d. Outdoor Air Ducts with a Pressure Class of **2-Inch wg** or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than **50 percent** of total installed duct area for each designated pressure class.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give **seven** days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Any liner showing evidence that it has wet at any time shall be removed and replaced with new liner.
 - a. Disinfect affected sheet metal, and pins.
 - b. Install new liner per specifications
 - c. Seal friable edges and seams of repaired liner.

D. Duct system will be considered defective if it does not pass tests and inspections.

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- E. Prepare test and inspection reports.

3.9 DUCT CLEANING

- A. Clean **new** duct system before testing, adjusting, and balancing.
- B. 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 duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "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.
- C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with **99.97 percent** collection efficiency for **0.3-micron**-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. 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.
- E. Mechanical Cleaning Methodology:

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1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel.
- B. Ductwork running in areas where there are no ceilings or when noted on the drawings shall be doubled wall duct and shall meet the requirements indicated below.
- C. Supply Ducts:
 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive **2-inch wg.**
 - b. Minimum SMACNA Seal Class: **A.**
 - c. SMACNA Leakage Class for Rectangular: **16.**
 - d. SMACNA Leakage Class for Round and Flat Oval: **8.**
 2. Ducts Connected to Constant-Volume Air-Handling Units:
 - a. Pressure Class: Positive **3-inch wg.**
 - b. Minimum SMACNA Seal Class: **A.**

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- c. SMACNA Leakage Class for Rectangular: **8**.
 - d. SMACNA Leakage Class for Round and Flat Oval: **4**.
 3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
 - a. Pressure Class: Positive **6-inch wg**.
 - b. Minimum SMACNA Seal Class: **A**.
 - c. SMACNA Leakage Class for Rectangular: **4**.
 - d. SMACNA Leakage Class for Round and Flat Oval: **2**.
 4. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive **4-inch wg**.
 - b. Minimum SMACNA Seal Class: **A**.
 - c. SMACNA Leakage Class for **Rectangular**: **4**.
 - d. SMACNA Leakage Class for Round and Flat Oval: **2**.
- D. Return Ducts:
 1. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative **2-inch wg**.
 - b. Minimum SMACNA Seal Class: **A**.
 - c. SMACNA Leakage Class for Rectangular: **16**.
 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative **3-inch wg**.
 - b. Minimum SMACNA Seal Class: **A**.
 - c. SMACNA Leakage Class for Rectangular: **8**.
 - d. SMACNA Leakage Class for Round: **4**.
- E. Exhaust Ducts:
 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative **2-inch wg**.
 - b. Minimum SMACNA Seal Class: **A**.
 - c. SMACNA Leakage Class for Rectangular: **16**.
 2. Ducts Connected to Type I (Grease) Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: 18 gauge Type 304, stainless-steel sheet, No. 4 finish.
 - b. Concealed: 16 gauge black steel.
 - c. Pressure Class: Positive or negative **3-inch wg**.
 - d. Welded seams and joints.
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - f. SMACNA Leakage Class: **2**.
 - g. A light test shall be performed for grease duct prior to concealing the duct.
 3. Ducts Connected to Type II (Heat) Commercial Kitchen Hoods:

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- a. Type 304, stainless-steel sheet.
 - b. **Exposed to View: No. 4 finish.**
 - c. **Pressure Class: Positive or negative 3-inch wg.**
 - d. Concealed: No. 2D finish.
 - e. Welded seams and joints.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: **2.**
4. Ducts Connected to Dishwasher and Low Temperature Vapor and Odor Hoods:
- a. Type 304, stainless-steel sheet.
 - b. **Exposed to View:** No. 4 finish.
 - c. **Pressure Class:** Positive or negative **3-inch wg.**
 - d. Concealed: No. 2D finish.
 - e. Welded seams and flanged joints with watertight EPDM gaskets.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations, flanged joints class A.
 - g. SMACNA Leakage Class: **2.**
5. Ducts Connected to Equipment Not Listed Above:
- a. Pressure Class: Positive or negative **4-inch wg.**
 - b. Minimum SMACNA Seal Class: **A.**
 - c. SMACNA Leakage Class for Rectangular: **4.**
 - d. SMACNA Leakage Class for Round: **2.**
- F. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: **Galvanized steel.**
 2. PVC-Coated Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: **Match duct material.**
 3. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: **Match duct material.**
 4. **Aluminum Ducts: Aluminum.**
- G. Duct Liner Restrictions:
1. Duct Liner exposed to air movement shall not be used on medium pressure ductwork (2000 to 4000 FPM velocity). See section 230713 "Duct Insulation" for insulation requirements.
 2. Duct Liner exposed to air movement shall not be used on high pressure ductwork (Greater than 4000 FPM velocity). See section 230713 "Duct Insulation" for insulation requirements.

3. All duct liner shall meet all of the requirements found in 2012 IECC

H. Liner: (Ductwork located in Unconditioned space)

1. Low Pressure Supply Air Ducts (Less than 2000 FPM velocity): **Fibrous glass, Type I, 1-1/2 inch** thick with a minimum R value of 6.0 for ducts in unconditioned spaces.
2. Supply Air Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1-1/2 inch** thick for ducts in unconditioned spaces.
3. Return Air Ducts: **Fibrous glass, Type I, 1-1/2 inch** thick with a minimum R value of 6.0 for ducts in unconditioned spaces.
4. Return Air Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1 inch** thick for ducts in conditioned spaces.
5. Exhaust Air Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1 inch** thick.
6. Supply Fan Plenums: **Fibrous glass, Type I, 1-1/2 inch** thick with a minimum R value of 6.0.
7. Return- and Exhaust-Fan Plenums: **Fibrous glass, Type II, 1-1/2 inch** thick with a minimum R value of 6.0.
8. Transfer Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1 inch** thick. **[1-1/2 inches] [2 inches]**.

I. Liner: (Ductwork located Interior to building Insulated Envelope)

1. Low Pressure Supply Air Ducts (Less than 2000 FPM velocity): **Fibrous glass, Type I, 1 inch** thick with a minimum R value of 4.0 for ducts in unconditioned spaces.
2. Supply Air Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1 inch** thick for ducts in conditioned spaces.
3. Return Air Ducts: **Fibrous glass, Type I, 1 inch** thick with a minimum R value of 4.0 for ducts in unconditioned spaces.
4. Return Air Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1 inch** thick for ducts in conditioned spaces.
5. Exhaust Air Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1 inch** thick.
6. Supply Fan Plenums: **Fibrous glass, Type I, 1 inch** thick with a minimum R value of 4.0.
7. Return- and Exhaust-Fan Plenums: **Fibrous glass, Type II, 1 inch** thick with a minimum R value of 4.0.

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8. Transfer Ducts: **Fibrous glass, Type I** [or flexible elastomeric] [Natural fiber], **1 inch** thick. [**1-1/2 inches**] [**2 inches**].

J. Double-Wall Duct Interstitial Insulation:

1. Supply Air Ducts: **1-1/2 inch** thick with a minimum R value of 6.0.
2. Return Air Ducts: **1-1/2 inch** thick with a minimum R value of 6.0.

K. Exterior Ductwork Liner Insulation:

1. Supply Air Ducts: **2 inch** thick with a minimum R value of 8.0.
2. Return Air Ducts: **2 inch** thick with a minimum R value of 8.0.

L. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity **1000 fpm** or Lower: 1.0 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity **1000 to 1500 fpm**: 1.5 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity **1500 fpm** or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, **12 Inches** and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, **14 Inches** and Larger in Diameter: Welded.

M. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry high efficiency take-off.

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- b. Rectangular Main to Round Branch: 45-degree entry high efficiency take-off.

2. **Round and Flat Oval**

- a. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
- b. Velocity **1000 to 1500 fpm: 45-degree entry high efficiency tap.**
- c. Velocity **1500 fpm** or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

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. Backdraft dampers.
 - 2. Pressure relief dampers.
 - 3. Barometric relief dampers.
 - 4. Manual volume dampers.
 - 5. Control dampers.
 - 6. Fire dampers.
 - 7. Smoke dampers.
 - 8. Combination fire and smoke dampers.
 - 9. Duct silencers.
 - 10. Turning vanes.
 - 11. Remote damper operators.
 - 12. Duct-mounted access doors.
 - 13. Flexible connectors.
 - 14. Flexible ducts.
 - 15. Duct accessory hardware.
 - 16. High efficiency take-offs.
- B. Related Requirements:

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1. Division 23 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Division 23 "Diffusers, Registers and Grilles".
3. Division 28 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.
4. Division 28 "Zoned (DC-Loop) Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 1. 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:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, pressure relief-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. 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.
- B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to **10** percent of amount installed.

1.7 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

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's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653.
 - 1. **Galvanized Coating Designation: G60.**
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Aluminum Sheets: Comply with **ASTM B 209**, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- C. Extruded Aluminum: Comply with **ASTM B 221**, Alloy 6063, Temper T6.
- D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-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 BACKDRAFT DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Greenheck Fan Corporation.
 3. Nailor Industries Inc.
 4. Pottorff.
 5. Ruskin Company.
 6. United Enertech
- B. Function:
1. Designed to allow airflow in one direction and prevent reverse airflow.
 2. Keeps outside air out of the space by sensing and closing against mass flow.
- C. Description: Gravity balanced.
- D. Maximum Air Velocity: **1000 fpm**
- E. Maximum System Pressure: **3-inch wg.**
- F. Frame: Hat-shaped, with welded corners or mechanically attached and mounting flange:
1. **16GA 0.063-inch- thick extruded aluminum.**
- G. Blades: Multiple single-piece blades, maximum **6-inch** width noncombustible, tear-resistant, neoprene-coated fiberglass with sealed edges:
1. **Center pivoted: 16GA 0.050-inch- thick aluminum sheet.**
- H. Blade Action: Parallel.
- I. Blade Seals: Mechanically locked, neoprene.
- J. Blade Axles: **0.20 inch** diameter: **Material: Nonferrous metal.**
- K. Tie Bars and Brackets: **Aluminum.**
- L. Return Spring: Adjustable tension.
- M. Bearings: **Synthetic pivot bushings.**
- N. Accessories.

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1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: **20 gage** minimum.
 - b. Sleeve Length: **6 inches** minimum.
4. Screen Mounting: Rear mounted.
5. Screen Material: **Aluminum**.
6. Screen Type: **Bird**
7. 90-degree stops.

2.4 PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Greenheck Fan Corporation.
 3. Nailor Industries Inc.
 4. Pottorff.
 5. Ruskin Company.
- B. Function:
 1. Provide component designed to protect HVAC systems by relieving air pressure from within a space that is beyond a pre-determined limit.
 2. To automatically begin to open at a pre-set pressure difference above maximum system pressure.
 3. Internally self-controlled with system pressure utilizing adjustable arms and weights.
 4. Self-actuated with system pressure utilizing adjustable arms and weights.
 5. Employs blade counterbalancing.
 6. Automatically closes and re-sets when pressures return to normal conditions.
- C. Air Velocity: **3900 fpm**.

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- D. Maximum System Pressure (MSP): **5-inch wg.**
- E. Differential Pressure Preset above MSP: **1-inch wg.**
- F. Maximum Damper Pressure Limit: **5.0-inch wg.**
- G. Frame Material: Flanged Channel: **14GA 0.079-inch- thick galvanized steel.**
- H. Frame Depth: **8-inch-** minimum.
- I. Blades:
 - 1. Material: **16GA 0.063-inch- formed galvanized steel.**
 - 2. Type: **Formed Sheetmetal.**
 - 3. Blade-stop: **With stop.**
- J. Blade Action: Parallel.
- K. Blade Seals: **Thermo-Plastic Elastomer.**
- L. Blade Axles:
 - 1. Material: **Plated steel.**
 - 2. **Diameter: 0.375 inch.**
- M. Linkage:
 - 1. **External heavy duty type with galvanized steel clevis arms and plated steel tie bars & pivot pins with nylon pivot bearings.**
- N. Bearings: **Galvanized Steel ball.**

2.5 BAROMETRIC RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. Pottorff.
 - 5. Ruskin Company.
- B. Function:

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1. Senses and compares outdoor ambient and indoor pressures.
2. Allows any higher pressure indoor air to escape.

C. Description: Suitable for horizontal or vertical mounting.

D. Maximum Air Velocity: **1000 fpm**

E. Maximum System Pressure: **3-inch wg**

F. Frame: Hat-shaped, with welded corners or mechanically attached and mounting flange.

1. **13GA 0.094-inch- thick, galvanized sheet steel.**

G. Blades: Multiple:

1. **16GA 0.050-inch- thick aluminum sheet.**

2. Maximum Width: **6 inches.**

3. Action: Parallel.

4. Balance: Gravity.

5. Pivot: **Eccentric.**

H. Blade Seals: **Neoprene**

I. Blade Axles: **Galvanized steel**

J. Tie Bars and Brackets: Rattle free with 90-degree stop.

1. Material: **Galvanized steel.**

K. Return Spring: Adjustable tension.

L. Bearings: **Synthetic**

2.6 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Warming and Ventilating; a division of Mestek, Inc.
 - b. McGill AirFlow LLC.
 - c. Nailor Industries Inc.
 - d. Pottorff.
 - e. Ruskin Company.

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- f. United Enertech
 2. Standard leakage rating , **with linkage outside airstream** .
 3. Suitable for horizontal or vertical applications.
 4. Frames: Hat-shaped, Mitered and welded corners. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - a. **16GA 0.064-inch thick, galvanized sheet steel.**
 5. Blades:
 - a. Multiple or single blade. Parallel- or opposed-blade design. Stiffened damper blades for stability.
 - b. Material: **Galvanized -steel, 16GA 0.064 inch thick.**
 6. Blade Axles:
 - a. **Nonferrous metal**
 - b. Shall extend full length of damper blades in ducts with pressure classes of **3-inch wg** or more.
 7. Bearings:
 - a. Material:
 - 1) **Molded synthetic.**
 - b. Bearings at both ends of damper operating shafts in ducts with pressure classes of **3-inch wg** or more.
 8. Tie Bars and Brackets: Galvanized steel.
- B. Low-Leakage, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Warming and Ventilating; a division of Mestek, Inc.
 - b. McGill AirFlow LLC.
 - c. Nailor Industries Inc.
 - d. Pottorff.
 - e. Ruskin Company.
 - f. United Enertech
 2. Comply with AMCA 500-D testing for damper rating.
 3. Low-leakage rating , **with linkage outside airstream**, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 4. Suitable for horizontal or vertical applications.
 5. Frames:

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- a. Frame: Hat-shaped,
 - 1) **16GA 0.064-inch** thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:
- a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Material:
 - 1) **Galvanized, roll-formed steel, 16GA 0.064 inch thick.**
7. Blade Axles:
- a. **Nonferrous metal.**
8. Bearings:
- a. **Molded synthetic.**
 - b. Dampers in ducts with pressure classes of **3-inch wg** or more shall have axles full length of damper blades and bearings at both ends of operating shaft.
9. Blade Seals: **Neoprene.**
10. Jamb Seals: Cambered **Stainless steel** or **aluminum.**
11. Tie Bars and Brackets: **Galvanized steel** or **aluminum.**
12. Accessories:
- a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- C. Jackshaft:
1. Size: **1-inch diameter.**
 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- D. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of **3/32-inch-** thick zinc-plated steel, and a **3/4-inch** hexagon locking nut.
 2. Include center hole to suit damper operating-rod size.

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3. Include elevated platform for insulated duct mounting.

2.7 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Pottorff.
3. Ruskin Company.
4. Young Regulator Company.
5. United Enertech

- B. Low-leakage rating, **with linkage outside airstream**, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

- C. Frames:

1. Section: **Hat** shaped.
2. Material: **20 GA 0.40-inch- thick galvanized steel**
3. Corners: **Mitered-and-welded.**

- D. Blades: Multiple.

1. Maximum blade width: **6 inches.**
2. **Opposed -blade design.**
3. Material: **Galvanized-steel.**
4. Thickness: **20 GA 0.40-inch- thick galvanized steel**
5. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

- a. **Closed-cell neoprene**

- E. Blade Axles:

1. Section: **3/8-inch-square**
2. Material: **Galvanized steel.**
3. Blade-linkage hardware:
 - a. Zinc-plated steel and brass.
 - b. Ends sealed against blade bearings:
4. Operating Temperature Range: From **minus 40 to plus 200 deg F.**

F. Bearings:

1. Type: **Molded synthetic.**
2. Axles: Dampers in ducts with pressure classes of **3-inch wg** or more shall have axles full length of damper blades.
3. Bearings: Thrust bearings at each end of every blade. Bearings at both ends of each operating shaft.

2.8 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arrow United Industries; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Pottorff.
5. Ruskin Company.
6. United Enertech

B. Type: **Dynamic.**

C. Standard: Rated and labeled according to UL 555 by an NRTL.

D. Closing rating in ducts up to **4-inch wg** static pressure class and minimum **2000-fpm** velocity.

E. Fire Rating: **1-1/2 hours.**

F. Frame: **Curtain type with blades outside airstream.**

1. Material:

- a. Fabricated with roll-formed galvanized steel; with mitered and interlocking corners.
- b. Thickness: **20GA-0.040-inch-.**

G. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel. Length to suit application.

1. Minimum Thickness: **18GA-0.05 inch, as indicated.**
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

H. Mounting Orientation: Vertical or horizontal as indicated.

I. Blades: Roll-formed, interlocking, galvanized sheet steel.

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1. Thickness: **24GA-0.024-inch-**
 2. In place of interlocking blades, use full-length, **0.034-inch-** thick, galvanized-steel blade connectors.
- J. Horizontal Dampers: Include blade lock and Type 301 constant force stainless-steel closure spring.
- K. **Heat-Responsive Device:** Replaceable, **212 deg F** rated, fusible links.

2.9 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
 2. Nailor Industries Inc.
 3. Pottorff.
 4. Ruskin Company.
 5. United Enertech
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Smoke Detector: Integral, factory wired for single-point connection.
1. Type: Photoelectric.
- D. Frame: Galvanized sheet steel. With or without mounting flange as required.
1. Thickness: **Hat-shaped, 16GA-0.064-inch.**
 2. Corners: **Welded.**
- E. Blades: Horizontal, galvanized sheet steel.
1. Section: **Roll-formed.**
 2. Fit: **Interlocking.**
 3. Thickness: **14GA-0.079-inch.**
- F. Leakage: **Class II.**
- G. Seals:
1. Blade: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of **450 deg F**.

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- H. Rated pressure and velocity to exceed design airflow conditions.
- I. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking.
 - 1. Minimum **17-inches** long.
 - 2. Thickness: **0.05-inch**.
- J. Damper Motors:
 - 1. Action: **Two-position**
 - 2. Mode: Fail close.
 - 3. Mounting: External.
- K. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Electrical Connection: **115 V, single phase, 60 Hz** .
- L. Accessories:
 - 1. Auxiliary switches for signaling: **Position indication.**
 - 2. Test Switch type: **Momentary test switch.**
 - 3. Test Switch Mounting: **Damper.**

2.10 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Pottorff.
 - 4. Ruskin Company.
 - 5. United Enertech
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to **4-inch wg** static pressure class and minimum velocity of **4000-fpm**

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- D. Fire Rating: **1-1/2 hours.**
- E. Frame: Hat shaped, galvanized sheet steel. With or without mounting flange as required.
 - 1. Thickness: **16GA-0.064-inch**
 - 2. Corners: **Welded.**
- F. **Heat-Responsive Device:** Replaceable, **212 deg F** rated, fusible links.
- G. Blades: Horizontal, galvanized sheet steel.
 - 1. Type: **Air-foil.**
 - 2. Fit: **Interlocking.**
 - 3. Thickness: **0.063-inch-**
- H. Leakage: **Class I.**
- I. Rated pressure and velocity to exceed design airflow conditions.
- J. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
 - 1. Thickness: **18GA 0.05-inch-**
- K. Master control panel for use in dynamic smoke-management systems.
- L. Damper Motors:
 - 1. Locate outside air stream unless otherwise indicated,
 - 2. Action: **Two-position.**
 - 3. Voltage: to match fire alarm system (coordinate).
 - 4. Listed: UL, as part of damper assembly.
 - 5. Outdoor Motors and Motors in Outside-Air Intakes:
 - a. Gaskets: O-ring gaskets designed to make motors weatherproof.
 - b. Internal heaters: Equip to permit normal operation at minus **40 deg F .**
- M. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Electrical Connection: 115 V, single phase, 60 Hz.
- N. Accessories:

1. Auxiliary switches:
 - a. **Signaling.**
 - b. **Position indication.**
2. Test Switch type: **Momentary test switch.**
3. Test Switch Mounting: **Damper.**

2.11 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. METALAIRE, Inc.
 2. SEMCO Incorporated.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 1. Fabricate single blade vanes to comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible."
 2. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- E. Vane Construction: **Single** wall
- F. Vane Spacing:
 1. 1-1/2" spacing between turning vanes
 2. **3-1/4" spacing not allowed.**
- G. Vane Construction: Single wall for ducts up to 36 **inches** wide and additional bracing for larger dimensions.

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2.12 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pottorff.
 - 2. Ruskin Company; Tomkins PLC.
 - 3. Young Regulator Company.
 - 4. Metropolitan Air Technologies.

- B. Cable Type:
 - 1. Description: Cable system designed for remote manual damper adjustment.
 - 2. Tubing/Sheathing: Galvinsed, Brass, Copper or Aluminum.
 - 3. Cable: Stainless steel or Steel.
 - 4. Wall-Box Mounting: Coordinate with Architect.
 - 5. Wall-Box Cover-Plate Material: Coordinate with Architect.

- C. Activated Electric Type:
 - 1. Description: Electrically activated zone control damper for remote adjustment. When an adjustment is needed the system is powered up.
 - 2. Means: Factory mounted actuator factory wired to damper.
 - 3. Portable **9 volt** system. No field power requirement.
 - 4. Mounting: Recessed Wall Box or Diffuser or Hand Held.
 - 5. Wall-Box Cover Finish: Coordinate with Architect.
 - 6. Wall-Box Porting: 1 to 6 ports or more.

2.13 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. McGill AirFlow LLC.
 - 3. Pottorff.
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 - 5. Ruskin Company

- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures **7-2**, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.

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- d. Hinges and Latches: **1-by-1-inch** butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
- 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than **12 Inches** Square: No hinges and two sash locks.
 - b. Access Doors up to **18 Inches** Square:
 - 1) Hinges: **Two hinges and two sash locks.**
 - c. Access Doors up to **24 by 48 Inches**, provide outside and inside handles:
 - 1) Hinges: **Three hinges and two compression latches.**
 - d. Access Doors Larger Than **24 by 48 Inches**, provide outside and inside handles:
 - e. Hinges: Continuous and two compression latches with outside and inside handles.

2.14 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Ventfabrics, Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Clamps: For sizes 3 through 18 inches, to suit duct size.
 - 1. Material: Stainless-Steel Band with cadmium-plated hex screw to tighten band with a worm-gear action.
 - 2. Clamps must be approved and listed with a UL181B-C listing.

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- D. Coatings and Adhesives: Comply with UL 181, Class 1.
 - 1. Adhesive Tape:
 - a. Material: Metalized polypropylene.
 - b. Tape must be approved and listed with a UL181B-FX listing.
- E. Metal-Edged Connectors: Factory fabricated with a wide fabric strip attached to two narrower metal strips. Provide strips of metal compatible with connected ducts and listed with a UL181B-C listing.
 - 1. Wide Strip: **3-1/2 inches.**
 - 2. Narrow Strips: **0.028-inch- thick, galvanized sheet steel.**
- F. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: **26 oz./sq. yd..**
 - 2. **Tensile Strength: 530 lbf/inch** in the warp and **440 lbf/inch** in the filling.
 - 3. Service Temperature: **Minus 40 to plus 200 deg F.**
 - 4. UL181B-C.
- G. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: **24 oz./sq. yd..**
 - 2. Tensile Strength: **530 lbf/inch** in the warp and **440 lbf/inch** in the filling.
 - 3. Service Temperature: **Minus 50 to plus 250 deg F.**
 - 4. UL181B-C.

2.15 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
 - 3. Themaflex
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Ducts shall conform to the requirements for Class I connectors when tested in

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accordance with "Standard for Factory Made Air Ducts Materials and Air Duct Connectors" (UL 181).

- C. Ducts shall also pass the 15 minute U.L. flame penetration test as specified in the UL 181 Standard.
- D. Insulated, Flexible Duct: Two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.
 - 1. Pressure Rating: **10-inch wg** positive and **1.0-inch wg** negative.
 - 2. Maximum Air Velocity: **4000 fpm**.
 - 3. Temperature Range: **Minus 10 to plus 160 deg F**.
 - 4. Insulation R-value: **Comply with ASHRAE/IESNA 90.1**.
- E. Flexible Duct Connectors:
 - 1. **Clamps:** in sizes **3 through 18 inches**, to suit duct size.
 - a. **Material:** Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action.

2.16 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.
- C. Splitter Damper Accessories: Zinc-plated damper blade bracket; **1/4-inch**, zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- D. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes **3 to 18 inches** to suit duct size.

2.22 HIGH EFFICIENCY TAKE-OFFS

A.Manufacturers: Subject to compliance with requirements, provide products by one of the following.

- 1. Air-Rite
- 2. Hercules Industries
- 3. Sheet Metal Connectors, Inc.

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4. Spiral Manufacturing Co. Inc.
 5. Ferguson
-
- B. Materials: 24 gauge galvanized sheet metal meeting ASTM A653 and A924
 - C. Take-off shall meet SMACNA third edition Section 4.8 figure 4.6 - 45 degree entry
 - D. Rectangular opening with flanged sides on all sides. Complete with closed cell neoprene gasket to provide a tight seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Use the Remote Damper Operator when they are called out on the drawings or when the damper cannot be easily accessed.
- D. Install high efficiency take-off on all branch duct take-offs. Provide take-off with balancing damper as shown on drawings. Spin-in fittings are not allowed.
- E. Install flexible connectors to connect ducts to equipment.
- F. Flexible duct connections from the main trunk ducts to diffuser boots shall be furnished and installed as shown on the drawings. Flexible ductwork shall only be used as indicated on the drawings.
- G. Where flexible duct is indicated, use insulated flexible duct for supply air return and exhaust air.
- H. Flexible ductwork shall be run in straight lengths.
- I. Provide support in flexible duct every three feet.
- J. Flexible ducts shall have compression fittings on both ends.
- K. Flexible ductwork is not allowed to bend 90 degrees. If a bend is needed use sheet-metal hard elbows. Hard turns, offsets, or kinks will not be allowed.
- L. Flexible ducts shall connect to trunk duct with high efficiency takeoffs.
- M. Connect flexible ducts to metal ducts with **draw bands**.

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- N. Connect terminal units to supply ducts **with maximum 12-inch lengths of flexible duct.**
- O. Do not use flexible ducts to change directions.
- P. Connect diffusers or light troffer boots to ducts: with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- Q. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- R. Install pressure relief damper immediately upstream of main fire damper.
- S. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- T. Set dampers to fully open position before testing, adjusting, and balancing. Exception: Pressure relief damper.
- U. A balance damper with locking quadrant will be provided downstream of take-off from trunk duct.
- V. For fans developing static pressures of **5-inch wg** and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- W. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of **1/4-inch** movement during start and stop of fans.
- X. Install duct test holes where required for testing and balancing purposes.
- Y. Install test holes at fan inlets and outlets and elsewhere as indicated.
- Z. Install fire **and smoke** dampers according to UL listing.
 - 1. Install fusible links in fire dampers.
- AA. For round ductwork **24-inch** and smaller a true round fire damper with the same rating may be used.
- BB. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On upstream side of duct coils.
 - 2. **Upstream** from duct filters.

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3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be **standard access doors** and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum **50-foot** spacing.
8. **Upstream** from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

CC. Install access doors with swing against duct static pressure.

DD. Access Door Sizes:

1. One-Hand or Inspection Access: **8 by 5 inches**.
2. Two-Hand Access: **12 by 6 inches**.
3. Head and Hand Access: **18 by 10 inches**.
4. Head and Shoulders Access: **21 by 14 inches**.
5. Body Access: **25 by 14 inches**.
6. Body plus Ladder Access: **25 by 17 inches**.
7. Grease Duct: **12 by 12 inches minimum**. Where such dimensions preclude installation, the opening shall be not less than 12 inches on one side and shall be large enough to provide access for cleaning and maintenance.

EE. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.

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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 full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

3.3 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 233300

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EDITORS COMMENT: SHAUNA 13/07/25; DELETE STRIKE THROUGH RED LINES 1.4; 2.2; 2.3.A, I, J; 2.4.A, I, J; 2.5.A, I, J, K; 2.6; 2.7; 2.8; 2.9; 3.3.

SECTION 233423 - HVAC POWER VENTILATORS

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. Utility set fans.
 - 2. Centrifugal roof ventilators.
 - 3. Axial roof ventilators.
 - 4. Upblast propeller roof exhaust fans.
 - 5. Centrifugal wall ventilators.
 - 6. Ceiling-mounted ventilators.
 - 7. In-line centrifugal fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on:
 - 1. Actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.
- C. Fan Schedule: Fan characteristics and performance data are described in an equipment schedule on the drawings including:
 - 1. Fan arrangement with wheel configuration, inlet and discharge configurations, and required accessories.
 - 2. Capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

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1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, shipping weights, operating weights, operating characteristics, and furnished specialties and accessories. Also include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
 - 7. Fan speed controllers.
- B. 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.
 - a. Detail all wiring systems and differentiate clearly between manufacturer-installed and field-installed wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Roof framing and support members relative to duct penetrations.
 - 2. Ceiling suspension assembly members.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control Reports

1.6 CLOSEOUT SUBMITTALS

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- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set for each belt-driven unit.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Power ventilator electrical components shall comply with applicable NEMA standards.
- D. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.
- E. TUV Certified: High Volume low speed fan shall comply with UL 507

1.9 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

1.10 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 PRODUCTS FURNISHED BUT NOT INSTALLED

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- A. Products furnished, but not installed, under this Section include roof curbs for roof-mounted exhaust fans. Roof curbs to be installed by Division 07, section "Roof Accessories".

2.2 UTILITY SET FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aerovent; a division of Twin City Fan Companies, Ltd.
 - 2. Greenheck Fan Corp.
 - 3. Hartzell Fan Incorporated.
 - 4. Loren Cook Company.
 - 5. New York Blower Company (The).
 - 6. PennBarry.
 - 7. Twin City
- B. Housing: Fabricated of steel with side sheets fastened with a deep lock seam or welded to scroll sheets.
 - 1. Housing Discharge Arrangement: Adjustable to eight standard positions.
- C. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.
 - 1. Blade Materials: **Steel**
 - 2. Blade Type: **Airfoil**
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves.
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9:
 - a. **L₅₀ of 200,000 hours.**
 - b. External Lubrication Lines: Lubricating tubes from fan bearings extended to accessible location outside of fan housing.
 - 3. Belt drives factory mounted, with final alignment and belt adjustment made after installation
 - 4. Service Factor Based on Fan Motor Size: **1.5**

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5. Motor Pulleys: Adjustable pitch for use with motors through **5 hp**; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
6. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
7. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
8. Fan Guard: **1/2- by 1-inch** mesh of galvanized steel in removable frame. Provide guard for inlet and/or outlet on units not connected to ductwork, where contact with fan wheel is within personal reach through access opening, or where falling objects and/or debris may enter fan.

E. Accessories:

1. Inlet and Outlet: Flanged.
2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
3. Inlet Screens: Removable wire mesh.
4. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades with felt edges in steel frame installed on fan discharge.
5. Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
6. Disconnect Switch: Nonfusible type: Thermal-overload protection; factory wired through an internal aluminum conduit mounted inside fan housing.

2.3 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aerovent; a division of Twin City Fan Companies, Ltd.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. Twin City.

B. Housing: Removable: Square, one-piece, aluminum base with venture inlet cone.

1. **Spun-aluminum, dome top and outlet baffle.**
2. **Hinged Subbase:** Galvanized-steel hinged arrangement permitting service and maintenance.

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C. Fan Wheels:

1. Aluminum hub and wheel with backward-inclined blades.

D. Direct-Drive Units: Motor mounted outside of airstream within fan housing.

E. Belt-Driven Units: Motor mounted on adjustable base, adjustable sheaves and with motor and belts within fan housing.

F. Accessories:

1. Disconnect Switch: Non-fusible type:

- a. Thermal-overload protection; factory wired through an internal aluminum conduit.

1) Mounted inside fan housing.

2. Bird Screens: Removable, **1/2-inch** mesh: **Aluminum wire.**

3. Dampers:

- a. **Counterbalanced, parallel-blade**, backdraft dampers mounted in curb base; factory set to close when fan stops.

- b. **Motorized parallel-blade** dampers mounted in curb base with electric actuator; wired to close when fan stops.

G. Roof Curbs: Galvanized steel; mitered and welded corners; **1-1/2-inch** thick, rigid, fiberglass insulation adhered to inside walls; and **1-1/2-inch** wood nailer. Size as required to suit roof opening and fan base. Provide neoprene gasket between fan base and curb to reduce sound transmission.

1. Configuration:

- a. **Self-flashing without a cant strip, with mounting flange.**

2. Overall Height: **8 inches**

3. Pitch Mounting: Manufacture curb for roof slope.

H. KITCHEN CENTRIFUGAL UPBLAST EXHAUSTERS

1. Spark-Resistant Construction: AMCA 99, Type **A**

2. Refer to Division 23 Section "Motors" for general requirements for factory-installed motors.

2.4 AXIAL ROOF VENTILATORS

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- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aerovent; a division of Twin City Fan Companies, Ltd.
 2. Greenheck Fan Corporation.
 3. Loren Cook Company.
 4. New York Blower Company (The).
 5. PennBarry.
 6. Twin City.
- B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; square, one-piece, hinged, aluminum base.
1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- C. Fan Wheel:
1. **Steel** hub and blades.
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing.
- E. Accessories:
1. Disconnect Switch: Nonfusible type:
 - a. Thermal-overload protection; factory wired through an internal aluminum conduit. **Mounted inside fan housing.**
 2. Bird Screens: Removable, **1/2-inch** mesh: **Aluminum wire.**
 3. Dampers:
 - a. **Counterbalanced, parallel-blade**, backdraft dampers mounted in curb base; factory set to close when fan stops.
 - b. **Motorized parallel-blade** dampers mounted in curb base with electric actuator; wired to close when fan stops.
- F. Roof Curbs: Galvanized steel; mitered and welded corners; **1-1/2-inch** thick, rigid, fiberglass insulation adhered to inside walls; and **1-1/2-inch** wood nailer. Size as required to suit roof opening and fan base. Provide neoprene gasket between fan base and curb to reduce sound transmission.
1. Configuration: **Self-flashing without a cant strip, with mounting flange.**
 2. Overall Height: **8 inches**

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2.5 UPBLAST PROPELLER ROOF EXHAUST FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aerovent; a division of Twin City Fan Companies, Ltd.
 - 2. Greenheck Fan Corporation.
 - 3. Hartzell Fan Incorporated.
 - 4. Loren Cook Company.
 - 5. New York Blower Company (The).
 - 6. PennBarry.
 - 7. Twin City

- B. Wind Band, Fan Housing, and Base:
 - 1. Reinforced and braced:**Galvanized steel**
 - 2. Containing **galvanized-steel** butterfly dampers and rain trough, motor and drive assembly, and fan wheel.
 - 3. Containing rain trough, motor and drive assembly, fan wheel and with butterfly dampers made of: **Galvanized-steel.**
 - 4. Damper Rods: Steel with **Bronze** bearings.
 - 5. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

- C. Fan Wheel: Replaceable;
 - 1. **Cast**-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.

- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing.

- E. Accessories:
 - 1. Disconnect Switch: Nonfusible type:
 - a. Thermal-overload protection; factory wired through an internal aluminum conduit. **Mounted inside fan housing.**
 - 2. Bird Screens: Removable, **1/2-inch** mesh: **Aluminum wire.**
 - 3. Dampers:

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- a. **Counterbalanced, parallel-blade**, backdraft dampers mounted in curb base; factory set to close when fan stops.
 - b. **Motorized parallel-blade** dampers mounted in curb base with electric actuator; wired to close when fan stops.
- F. Roof Curbs: Galvanized steel; mitered and welded corners; **1-1/2-inch**- thick, rigid, fiberglass insulation adhered to inside walls; and **1-1/2-inch** wood nailer. Size as required to suit roof opening and fan base. Provide neoprene gasket between fan base and curb to reduce sound transmission.
1. Configuration: **Self-flashing without a cant strip, with mounting flange.**
 2. Overall Height: **8 inches**
 3. Pitch Mounting: Manufacture curb for roof slope.

2.6 CENTRIFUGAL WALL VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aerovent; a division of Twin City Fan Companies, Ltd.
 2. Ammerman; Millennium Equipment.
 3. Greenheck Fan Corporation.
 4. Hartzell Fan Incorporated.
 5. Loren Cook Company.
 6. PennBarry.
 7. Twin City.
- B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.
- C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.
1. Fan Guard: **1/2- by 1-inch** mesh of galvanized steel in removable frame. Provide guard for inlet on units not connected to ductwork, where contact with fan wheel is within personal reach through access opening, or where falling objects and/or debris may enter fan.
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing.
- E. Accessories:
1. Bird Screens: Removable, **1/2-inch** mesh: **Aluminum wire.**

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2. Dampers:
 - a. **Counterbalanced, parallel-blade**, backdraft dampers mounted in curb base; factory set to close when fan stops.
 - b. **Motorized parallel-blade** dampers mounted in curb base with electric actuator; wired to close when fan stops.

2.7 CEILING-MOUNTED VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Loren Cook Company.
 2. Twin City.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: With flange on intake and thumbscrew attachment to fan housing.
 1. **Painted steel.**
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

2.8 IN-LINE CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Greenheck Fan Corporation.
 2. Loren Cook Company.
 3. Twin City.
- B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing with: **Wheel, inlet cone.**
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

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1. Fan Guard: **1/2- by 1-inch** mesh of galvanized steel in removable frame. Provide guard for inlet or outlet on units not connected to ductwork, where contact with fan wheel is within personal reach through access opening, or where falling objects and/or debris may enter fan.

F. Accessories:

1. Dampers:
 - a. **Counterbalanced, parallel-blade**, backdraft dampers mounted in curb base; factory set to close when fan stops.
 - b. **Motorized parallel-blade** dampers mounted in curb base with electric actuator; wired to close when fan stops. These dampers to be black in all cases.
2. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
3. Disconnect Switch: Nonfusible type:
 - a. Thermal-overload protection; factory wired through an internal aluminum conduit. **Mounted inside fan housing.**

2.9 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
- B. Enclosure Type: Totally enclosed; **Fan cooled**

2.10 FACTORY FINISH

- A. Metal Parts: All assembly parts shall be protected from rust and corrosion.
 1. Stainless steel, aluminum, and other non-corroding materials require no protective finish.
 2. Non-galvanized sheet metal parts shall be prime coated or powder coated before final assembly.
 3. Prime coated parts shall receive baked enamel finish coat after assembly.

2.11 SOURCE QUALITY CONTROL

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- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the power ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements. Verify clearances.
- B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated, and fans have been commissioned.

3.3 INSTALLATION

- A. Install power ventilators level and plumb according to manufacturer's written instructions.
- B. Base Mounted Equipment:
 - 1. Install power ventilators on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in: **Division 33 "Cast-in-Place Concrete."**
- C. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.
- D. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- E. **Support Steel:** Support suspended units from structure using threaded steel as specified in Division 23 "Vibration and Seismic Controls for HVAC."
- F. Label units according to requirements specified in Division 23 "Identification for HVAC Piping and Equipment."

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- G. Install power ventilators with factory recommended and code required clearances for service and maintenance.

3.4 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 "Grounding and Bonding for Electrical Systems."
 - 1. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Connect wiring according to Division 26 "Low-Voltage Electrical Power Conductors and Cables."
 - 1. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 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.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Division 23 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

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3.7 CLEANING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
- B. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout."
- C. Schedule training with Owner, through Architect, with at least 7 days' advance notice.
- D. Demonstrate operation of power ventilators. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each power ventilator.

END OF SECTION 233423

SECTION 233600 - AIR TERMINAL UNITS

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. Shutoff, single-duct air terminal units.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.
 - 4. Seismic-restraint devices.
- B. Shop Drawings: For air terminal units. 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:
 - a. For power, signal, and control wiring.
 - b. Differentiate between manufacturer-installed and field-installed wiring.
 - 3. **Hangers and supports**, including methods for duct and building attachment and vibration isolation.
- C. Delegated-Design Submittal:
 - 1. Materials, fabrication, assembly, and spacing of hangers and supports.

2. **Design Calculations:** Calculations, **including analysis data signed and sealed by the qualified professional engineer responsible for their preparation** for selecting hangers and supports.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 1. Ceiling suspension assembly members.
 2. Size and location of initial access modules for acoustic tile.
 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control reports.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Air terminal units shall withstand the effects of earthquake motions determined according to **SEI/ASCE 7**.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 1. Instructions for resetting minimum and maximum air volumes.
 2. Instructions for adjusting software set points.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fan-Powered-Unit Filters: Furnish **one** spare filter for each filter installed.

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1.8 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- B. Product Options: Drawings and schedules indicate requirements of air terminals and are based on specific systems indicated. Other manufacturers' systems with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- C. Listing and Labeling: Provide electrically operated air terminals specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
- D. NFPA Compliance: Install air terminals according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- E. Comply with NFPA 70 for electrical components and installation.

1.9 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. **Structural Performance:** Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Anemostat Products; a Mestek Company.

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2. Carnes.
 3. Environmental Technologies, Inc.
 4. Krueger.
 5. METALAIRE, Inc.
 6. Nailor Industries Inc.
 7. Price Industries.
 8. Titus.
 9. Trox USA Inc.; a subsidiary of the TROX GROUP.
 10. Tuttle & Bailey.
 11. Warren Technology.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. **Casing: 0.034-inch steel, single wall.**
1. **Casing Lining:** Adhesive attached, **coated, fibrous-glass duct liner** complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - a. Lining thickness: **1/2-inch**
 - b. Cover liner with nonporous foil.
 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Air Outlet: S-slip and drive connections **size matching inlet size.**
 5. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage:
 - a. ARI 880 rated, **3** percent of nominal airflow at **3-inch wg** inlet static pressure.
 2. Damper Position: Normally **open.**

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- E. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than **0.1 inch**, and rated for a minimum working pressure of **200 psig** and a maximum entering-water temperature of **220 deg F**. Include manual air vent and drain valve.

 - L. Direct Digital Controls: Bidirectional damper operators and microprocessor-based controller and room sensor. Control devices shall be compatible with temperature controls specified in Section 230900 "Instrumentation and Control for HVAC" and shall have the following features:
 - 1. **Damper Actuator: 24 V, powered closed, spring return open.**
 - 2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
 - a. Occupied and unoccupied operating mode.
 - b. Remote reset of airflow or temperature set points.
 - c. Adjusting and monitoring with portable terminal.
 - d. Communication with temperature-control system specified in Section 230900 "Instrumentation and Control for HVAC."
 - 3. Room Sensor: Wall mounted with temperature set-point adjustment and access for connection of portable operator terminal.

 - F. Control Sequence:
 - 1. Suitable for operation with duct pressures between **0.25- and 3.0-inch wg** inlet static pressure.
 - 2. System-powered, wall-mounted thermostat.
- 2.4 HANGERS AND SUPPORTS
- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
 - B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
 - C. **Steel Cables: Galvanized steel complying with ASTM A 603.**
 - D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
 - E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
 - F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.5 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
 - 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.
- D. Install discharge air temperature sensors at the outlet of each Air Terminal Unit.
- E. Connect ductwork to air terminals according to Division 23 ductwork Sections.
- F. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."
- G. For Diffuser Type Air Terminal Units, provide and install all necessary control wiring and control voltage transformer. See drawings AND schedules for additional information.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than **4 inches** thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than **4 inches** thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.

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- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to **Section 233113 "Metal Ducts.**
- D. Electrically ground all equipment:
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

- A. **Testing Agency: Owner will engage** a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.

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2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Air terminal unit will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Cleaning:
1. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

3.6 STARTUP SERVICE

- A. **Engage a factory-authorized service representative to perform** startup service.
1. Complete installation and startup checks according to:
 - a. Manufacturer's written instructions.
 - b. Construction documents.
 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 3. Verify that controls and control enclosure are accessible.
 4. Verify that control connections are complete.
 5. Verify that nameplate and identification tag are visible.
 6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

- A. **Engage a factory-authorized service representative to train** Owner's maintenance personnel to adjust, operate, and maintain air terminal units:
1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
 2. Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."

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3. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
4. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION 233600

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SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections:
 - 1. Section 233714 "Fixed Louvers" for fixed and louvers and wall vents, whether or not they are connected to ducts.
 - 2. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
 - 3. Section 230594 "General Testing, Adjusting and Balancing" for balancing diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.

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3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated.
- B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

1.6 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Air Factors
 2. Carnes.
 3. Kruegar.
 4. METALAIRE, Inc.
 5. Nailor Industries Inc.
 6. Price Industries.
 7. Titus.
 8. Tuttle & Bailey.
 9. Air Concepts.

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10. Trox.

2.2 REGISTERS, GRILLES, & DIFFUSERS

- A. General: The frames for all registers, grilles, and diffusers shall match type of ceiling where they are to be installed. Special frames shall be provided for narrow T-bar ceilings. Refer to reflected ceiling plan and other specification divisions for ceiling type. See drawings AND schedules for additional information.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, coordination drawings, original design, and referenced standards.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

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3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

SECTION 233714 - FIXED LOUVERS

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. Fixed, **extruded-aluminum** louvers.
- B. Related Requirements:
 - 1. Section 099113 "Exterior Painting" for field painting louvers.

1.3 DEFINITIONS

- A. 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.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).
- C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).
- D. 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of 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, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

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1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 2. Show mullion profiles and locations.
- C. Samples: For each type of metal finish required.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to 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.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain 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. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7]**.
1. Design Spectral Response Acceleration at Short Periods: Per the structural drawings and specifications.

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2. Component Importance Factor: **[1.5] [1.0]**.

- B. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVER

A. Horizontal, Drainable-Blade Louver :

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Airolite Company, LLC (The).
 - b. Pottorff.
 - c. Ruskin Company; Tomkins PLC.
 - d. Greenheck Fan Corporation.
- 2. Louver Performance Ratings:
 - a. Free Area: Not less than **8.5 sq. ft.** for 48-inch- wide by 48-inch- high louver.
 - b. Point of Beginning Water Penetration: Not less than **1250 fpm.**
 - c. Air Performance – **intake:** Not more than **0.10-inch wg** static pressure drop at **900-fpm** free-area velocity.
 - d. Air Performance – **exhaust:** Not more than **0.15-inch wg** static pressure drop at **1000-fpm** free-area velocity.
- 3. 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 **machine screws with heads finished to match louver**, spaced a maximum of 6 inches from each corner and at 12 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. **Reinforce extruded-aluminum screen frames at corners with clips.**
- 2. Finish: **Same finish as louver frames to which louver screens are attached**

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3. Type: **Rewirable frames with a driven spline**

- D. Louver Screening for Aluminum Louvers:

2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
C. Fasteners: Use types and sizes to suit unit installation conditions.
1. Contractor shall use **or hex-head or** screws for exposed fasteners screws for exposed fasteners unless otherwise indicated.
 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 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. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. 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.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Join frame members to each other and to fixed louver blades with fillet welds **concealed from view** unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.7 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. Color Anodic Finish: AAMA 611, or thicker.
 - 1. Color: **As selected by Architect from full range of industry colors and color densities.**
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: **As selected by Architect from manufacturer's full range**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying

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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 weather-tight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 233714

SECTION 233813 - COMMERCIAL-KITCHEN HOODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes Type I commercial kitchen hoods.
- B. Hoods shall be UL listed,
- C. Hoods interlocked with associated exhaust fan and make-up air via heat sensor in hood (IMC 2021).
- D. Provide liquid chemical fire suppression system on Type I kitchen exhaust hoods (locate in utility cabinet on end of unit.)
- E. Require capture and containment and performance test on all kitchen exhaust hoods (IMC 2021)
- F. Provide an automatic gas valve by this division which will shut down when alarmed.
- G. Provide grease filters.
- H. The hood is to supply and exhaust air. See schedule for how the supply air is introduced into the hood.

1.3 DEFINITIONS

- A. Type I Hood: A hood designed for grease exhaust applications.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Standard hoods.
 - 2. Filters/baffles.
 - 3. Fire-suppression systems.

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4. Lighting fixtures.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
1. Shop Drawing Scale: 1/4 inch = 1 foot.
 2. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.
 3. Show cooking equipment plan and elevation to confirm minimum code-required overhang.
 4. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
 5. Show water-supply and drain piping connections.
 6. Show control cabinets.
 7. Show fire-protection cylinders, piping, actuation devices, and manual control devices.
 8. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 9. Design Calculations: Calculate requirements for selecting seismic restraints.
 10. Wiring Diagrams: Power, signal, and control wiring.
 11. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Include roughing-in requirements for drain connections. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.
 - a. Piping Diagram Scale: 1/4 inch = 1 foot.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Coordination Drawing Scale: 1/4 inch = 1 foot.
 2. Suspended ceiling assembly components.
 3. Structural members to which equipment will be attached.
 4. Roof framing and support members for duct penetrations.
 5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.

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- b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Moldings on hoods and accessory equipment.

 - D. Welding certificates.

 - E. Manufacturer Seismic Qualification Certification: Submit certification that commercial kitchen hoods, accessories, and components will withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

 - F. Field quality-control test reports.
- 1.5 QUALITY ASSURANCE
- A. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- 1.6 OWNER SPECIFICATION COMPLIANCE
- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.
- 1.7 COORDINATION
- A. Coordinate equipment layout and installation with adjacent Work, including lighting fixtures, HVAC equipment, plumbing, and fire-suppression system components.

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1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish one complete set(s) of grease filters/baffles.

PART 2 - PRODUCTS

2.1 HOOD MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304.
 - 1. Minimum Thickness: 0.037 inch.
 - 2. Finish: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.
 - a. Finish shall be free from tool and die marks and stretch lines and shall have uniform, directionally textured, polished finish indicated, free of cross scratches. Grain shall run with long dimension of each piece.
 - 3. Exposed Surfaces: ASTM A 480/A 480M, No. 3 finish (intermediate polished surface).

2.2 GENERAL HOOD FABRICATION REQUIREMENTS

- A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.
 - 1. Welded Butt Joints: Full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.
 - 2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
 - 3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.
 - 4. Coat concealed stainless-steel welded joints with metallic-based paint to prevent corrosion.
 - 5. After zinc-coated steel is welded, clean welds and abraded areas and apply SSPC-Paint 20, high-zinc-dust-content, galvanizing repair paint to comply with ASTM A 780/A 780M.

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- B. For metal butt joints, comply with SMACNA's "Kitchen Equipment Fabrication Guidelines."
- C. Where stainless steel is joined to a dissimilar metal, use stainless-steel welding material or fastening devices.
- D. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.
- E. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.
- F. In food zones, as defined in NSF, fabricate surfaces free from exposed fasteners.
- G. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.
- H. Fabricate pipe slots on equipment with turned-up edges sized to accommodate service and utility lines and mechanical connections.
- I. Fabricate enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets, unless otherwise indicated.
- J. Fabricate seismic restraints according to SMACNA's "Kitchen Equipment Fabrication Guidelines," Appendix 1, "Guidelines for Seismic Restraints of Kitchen Equipment."
- K. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Equipment Fabrication Guidelines."
- L. Fabricate enclosure panels to ceiling and wall as follows:
 - 1. Fabricate panels on all exposed side(s) (see drawings) with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.
 - 2. Wall Offset Spacer: Minimum of 3 inches.
 - 3. Wall Shelves and Overshelves: Fabricate according to SMACNA's "Kitchen Equipment Fabrication Guidelines," with minimum 0.0625-inch- thick, stainless-steel shelf tops.

2.3 TYPE I EXHAUST HOOD FABRICATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Captive-Aire Systems.
 - 2. Gaylord Industries, Inc.
 - 3. Greenheck.

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4. Econ-Air
- B. Weld all joints exposed to grease with continuous welds, and make filters/baffles or grease extractors and makeup air diffusers easily accessible for cleaning.
 1. Fabricate hoods according to NSF 2, "Food Equipment."
 2. Hoods shall be listed and labeled, according to UL 710, by a testing agency acceptable to authorities having jurisdiction.
 3. Hoods shall be designed, fabricated, and installed according to NFPA 96.
 4. Include access panels as required for access to fire dampers and fusible links.
 5. Duct Collars: Minimum 0.0598-inch- thick steel at least 3 inches long, continuously welded to top of hood and at corners.
 6. Duct-Collar Fire Dampers: Collar and damper shall comply with UL 710 testing and listing required for the entire hood.
 - a. Collar: Minimum 0.0598-inch- thick stainless steel, at least 3 inches long, continuously welded to top of hood and at corners. Fabricate a collar with a minimum 0.5-inch- wide duct flange.
 - b. Blades: Minimum 0.1046-inch- thick stainless steel, counterbalanced to remain closed after actuation.
 - c. Blade Pivot and Spring: Stainless steel.
 - d. Fusible Link: Replaceable, 212 deg F rated.
 7. Makeup Air Fire Dampers: Labeled, according to UL 555, by a testing agency acceptable to authorities having jurisdiction.
 - a. Fire Rating: 1-1/2 hours.
 - b. Frame: SMACNA Type B, with blades in airstream; fabricated with roll-formed, stainless steel; with mitered and interlocking corners.
 - c. Blades: Roll-formed, interlocking or folded, minimum 0.034-inch- thick, galvanized-steel sheet.
 - d. Horizontal Dampers: Include a blade lock and stainless-steel closure spring.
 - e. Fusible Link: Replaceable, 165 deg F 212 deg F rated.
 8. The hood shall have a double wall insulated front.
- C. Hood Configuration: Exhaust and makeup air.
 1. Makeup air shall be introduced through laminar-flow-type, perforated metal panels on front of hood canopy.
- D. Hood Style: (See Drawings).
- E. Filters/Baffles: Removable, stainless-steel, with spring-loaded fastening. Fabricate stainless steel for filter frame and removable collection cup and pitched trough. Exposed surfaces shall be pitched to drain to collection cup. Filters/baffles shall be tested according to UL 1046, "Grease Filters for Exhaust Ducts," by an NRTL acceptable to authorities having jurisdiction.

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- F. Lighting Fixtures: Surface-mounted, incandescent fixtures and lamps with lenses sealed vaportight. Wiring shall be installed in conduit on hood exterior. Number and location of fixtures shall provide a minimum of 70 fc at 30 inches above finished floor.
 - 1. Light switches shall be mounted in hood control panel.
 - 2. Lighting Fixtures: Incandescent complying with UL 1598.

- G. Hood Controls: Hood-mounting control cabinet, fabricated of stainless steel.
 - 1. Exhaust Fan: On-off switches shall start and stop the exhaust fan. Interlock exhaust fan with makeup air supply fan to operate simultaneously. Interlock exhaust fan with fire-suppression system to operate fan(s) during fire-suppression-agent release and to remain in operation until manually stopped. Include red pilot light to indicate fan operation. Motor starters shall comply with Division 26 Section "Enclosed Controllers."
 - 2. Exhaust Fan Interlock: Factory wire the exhaust fan starters in a single control cabinet for adjacent hoods to operate together.
 - 3. Photocell and Temperature Control: Cycle makeup air and exhaust-air fans on and off, based on temperature at hood discharge and opacity of smoke in hood. Interlock fan control with fire-suppression system to operate during fire-suppression-agent release and to remain in operation until manually stopped. Provide air-purge fan and conduit to photocell and reflector to avoid grease accumulation that will negatively affect performance of system.
 - 4. High-Temperature Control: Alarm shall sound and cooking equipment shall shut down before hood discharge temperature rises to actuation temperature of fire-suppression system.

2.4 FIRE-SUPPRESSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ansul Incorporated; a Tyco International Ltd. Company.

- B. Description: Engineered distribution piping designed for automatic detection and release or manual release of fire-suppression agent by hood operator. Fire-suppression system shall be listed and labeled for complying with NFPA 17A, "Wet Chemical Extinguishing Systems," by a qualified testing agency acceptable to authorities having jurisdiction.
 - 1. Steel Pipe, NPS 2 and Smaller: ASTM A 53/A 53M, Type S, Grade A, Schedule 40, plain ends.
 - 2. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.

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3. Piping, fusible links and release mechanism, tank containing the suppression agent, and controls shall be factory installed. Controls shall be in stainless-steel control cabinet mounted on hood or wall. Furnish manual pull station for wall mounting. Exposed piping shall be covered with chrome-plated aluminum tubing. Exposed fittings shall be chrome plated.
4. Liquid Extinguishing Agent: Noncorrosive, low-pH liquid.
5. Furnish electric-operated gas shutoff valve by this division; refer to Division 23 Section "Facility Natural-Gas Piping."
6. Furnish electric-operated gas shutoff valve with clearly marked open and closed indicator for field installation.
7. Fire-suppression system controls shall be integrated with controls for fans, lights, and fuel supply and located in a single cabinet for each group of hoods immediately adjacent.
8. Wiring shall have color-coded, numbered terminal blocks and grounding bar. Spare terminals for fire alarm, optional wiring to start fan with fire alarm, red pilot light to indicate fan operation, and control switches shall all be factory wired in control cabinet with relays or starters. Include spare terminals for fire alarm, and wiring to start fan with fire alarm.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Complete field assembly of hoods where required.
 1. Make closed butt and contact joints that do not require filler.
 2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in Part 2 "General Hood Fabrication Requirements" Article.
- B. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, grease extractor, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.
- C. Make cutouts in hoods where required to run service lines and to make final connections, and seal openings according to UL 1978.
- D. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners, unless otherwise indicated.
- E. Install hoods to operate free from vibration.

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- F. Install seismic restraints according to SMACNA's "Kitchen Equipment Fabrication Guidelines," Appendix 1, "Guidelines for Seismic Restraints of Kitchen Equipment."
- G. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches o.c. maximum.
- H. Install sealant in joints between equipment and abutting surfaces with continuous joint backing, unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.
- I. Install lamps, with maximum recommended wattage, in equipment with integral lighting.
- J. Set initial temperatures, and calibrate sensors.
- K. Set field-adjustable switches.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping with clearance to allow service and maintenance.
- C. Connect ducts according to requirements in Division 23 Section "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquid tight joint.
- D. Install fire-suppression piping for remote-mounted suppression systems according to NFPA 17A, "Wet Chemical Extinguishing Systems."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

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- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Test water, drain, gas, and liquid-carrying components for leaks. Repair or replace leaking components.
 - 4. Perform hood performance tests required by authorities having jurisdiction.
 - 5. Perform fire-suppression system performance tests required by authorities having jurisdiction.
- E. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial kitchen hoods. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 235813

SECTION 237310 – ROOF-TOP AIR CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following rooftop air conditioners:

1. Cooling and heating units 2 to 20 tons.
2. Provide isolated curb with unit.

1.2 SUBMITTALS

- A. Product Data: For each model indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Prepare the following by or under the supervision of a qualified professional engineer:
1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
 2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
 3. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and maintenance data.
- E. Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

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- D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- E. Comply with NFPA 54 for gas-fired furnace section.
- F. ARI Compliance for Units with Capacities Less Than 135,000 Btuh: Rate rooftop air-conditioner capacity according to ARI 210/240, "Unitary Air-Conditioning and Air-Source Heat Pump Equipment."
 - 1. Sound Power Level Ratings: Comply with ARI 270, "Sound Rating of Outdoor Unitary Equipment."
- G. ARI Compliance for Units with Capacities 135,000 Btuh and More: Rate rooftop air-conditioner capacity according to ARI 340/360, "Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment."
 - 1. Sound Power Level Ratings: Comply with ARI 270, "Sound Rating of Outdoor Unitary Equipment."
- H. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled. The rooftop unit(s) shall be certified in accordance with UL Standard 1995 and ANSI Standard Z21.47. The rooftop unit(s) shall be safety certified by an accredited testing laboratory and the nameplate shall carry the label of the certification agency.

1.4 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of rooftop air conditioners that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 - 2. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.
 - 3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

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1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver rooftop units as factory-assembled units with protective crating and covering as recommended by the manufacturer.
- B. Coordinate delivery of units in sufficient time to allow movement into building.
- C. Handle rooftop units to comply with manufacturer's written rigging and installation instructions for unloading and moving to final location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 ROOFTOP AIR CONDITIONERS 5 TO 20 TONS

- A. Manufacturers:
 - 1. AAON, Inc.
 - 2. Addison
 - 3. Govern-aire
- B. Description: Factory assembled and tested; designed for exterior installation; consisting of compressor, indoor and outside refrigerant coils, indoor fan and outside coil fan, refrigeration and temperature controls, filters, and dampers.
- C. Casing: Unit shall be specifically designed for outdoor roof top application with a fully weatherproof cabinet.
 - 1. Cabinet shall be constructed entirely of G90 galvanized steel with the exterior constructed of 20 gauge or heavier material.
 - 2. Paint finish shall be capable of withstanding at least 2000 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
 - 3. The unit roof shall be sloped or cross-broken to assure drainage.
 - 4. Access to filters, blower, heating section, and other items needing periodic checking or maintenance shall be through hinged access doors with quarter turn latches. Door fastening screws are not acceptable.

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5. Access doors shall have stainless steel hinges and full perimeter gasketing. All access doors shall have an internal metal liner to protect the door ½ inch thick, 1 ½ lb. density fiberglass insulation.
 6. All openings through the base pan of the unit shall have upturned flanges of at least 1/2" in height around the opening through the base pan.
 7. Air side service access doors shall have rain break overhangs.
 8. The interior air side of the cabinet shall be entirely insulated on all exterior panels with 1 inch thick, 1 1/2 lb. density fiberglass insulation.
 9. Unit specific color coded wiring diagrams shall match the unit color coded wiring and will be provided in both point-to-point and ladder form. Diagrams shall also be laminated in plastic and permanently affixed inside the control compartment. Unit shall have decals and tags to indicate unit lifting and rigging, service areas and caution areas. Installation and maintenance manuals shall be supplied with each unit.
- D. Indoor Fan: All belt drive blower(s) shall have backward inclined airfoil blades. All direct drive blower(s) shall have forward curved blades. Provide grease-lubricated ball bearings, and motor.
- E. Outside Coil Fan: Propeller type, directly driven by permanently lubricated motor.
- F. Refrigerant Coils: Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor. Evaporator coils shall be furnished with a thermostatic expansion valve. Evaporator coils shall be furnished with a double sloped drain pan for the positive drainage of condensate. Evaporator coil drain pan(s) shall be fabricated of 304 stainless steel.
- G. Compressor(s): Hermetic scroll compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief, and crankcase heater(s).
1. Compressors shall be mounted in an isolated compartment to permit operation of the unit without affecting air flow when the door to the compartment is open.
 2. Compressors shall be isolated from the base pan and supply air to avoid any transmission of noise from the compressor into the building area..
- H. Refrigeration System:
1. Compressor(s).
 2. Outside coil and fan.
 3. Indoor coil and fan.
 4. Four-way reversing valve and suction line accumulator.
 5. Check valves.

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6. Expansion valves with replaceable thermostatic elements.
 7. Refrigerant dryers.
 8. High-pressure switches.
 9. Low-pressure switches.
 10. Thermostats for coil freeze-up protection during low-ambient temperature operation or loss of air.

 11. Independent refrigerant circuits.
 12. Brass service valves installed in discharge and liquid lines.
 13. Charge of refrigerant.

 14. Hot-Gas Bypass: Factory-installed valve.
 15. Timed Off Control: Automatic-reset control shuts compressor off after five minutes.
 16. Liquid line sight glasses and suction and discharge service isolation valves
- I. Filters: 4-inch- thick, fiberglass, pleated, filters in filter rack. Provide magnehelic gauge in controls compartment and clogged filter switch.
- J. Heat Exchanger: Stainless-steel construction for natural-gas-fired burners. Unit shall heat using natural gas and be equipped with a modulating gas valve, adjustable speed combustion blower and stainless steel tubular heat exchanger. The heat exchanger shall have a 25 year non pro-rated warranty. The completely factory mounted gas heating assembly shall be capable of operating at any firing rate between 100% and 30% of rated capacity. The combustion air and gas firing rate shall both be capable of modulation. A discharge air sensor shall be provided for field installation in the supply air ductwork to sense the discharge air temperature. The discharge air setpoint shall be adjusted at the electronic controller within the rooftop unit control compartment. Heating control shall be capable of operation initiated by:
1. A "W1" call for heat from a thermostat.
 2. 0 to 10 volt signal from a DDC control system.
 3. Provide with the following controls:
 - a. Redundant dual gas valve with manual shutoff.
 - b. Direct-spark pilot ignition.
 - c. Electronic flame sensor.
 - d. Induced-draft blower.
 - e. Flame rollout switch.
- K. Economizer: Return- and outside-air dampers with neoprene seals, outside-air filter, and hood.

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1. Damper Motor: Fully modulating spring return with adjustable minimum position.
 2. Control: Electronic-control system uses mixed-air temperature and selects between outside-air and return-air enthalpy to adjust mixing dampers.
- L. Unit Controls: Solid-state control board and components contain at least the following features:
1. Indoor fan on/off delay.
 2. Default control to ensure proper operation after power interruption.
 3. Service relay output.
 4. Unit diagnostics and diagnostic code storage.
 5. Field-adjustable control parameters.
- M. Electromechanical Thermostat: Staged heating and cooling on subbase with manual system switch (on-heat-auto-cool) and fan switch (auto-on).
1. Night setback operation with single-stage heating control with seven-day 24-hour time clock with battery backup.
 2. Fan-proving switch to lock out unit if fan fails.
 3. Dirty-filter switch.
 4. Tie into BAS through interlock at the RTU for monitoring only. All control devices from this interface shall be provided by the BAS contractor.
- N. Accessories:
1. Cold-Weather Kit: Electric heater maintains temperature in gas burner compartment and controls down to -40°F.
 2. PVC condensate drain trap.
 3. Dirty-filter switch.
 4. Vertical vent extension.
 5. Supply air smoke detector
 6. Non-fused disconnect switch
 7. Factory wired GFCI outlet
- O. Roof Curb: Steel with corrosion-protection coating, gasketing, and factory-installed wood nailer; complying with NRCA standards; minimum height of 26 inches. Provide Isolated Curb as detail below.

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1. All rooftop air-handling units shall be supported by vibration isolation curbs as manufactured by Kinetics Noise Control. The vibration isolation curbs shall be complete assemblies designed to resiliently support the equipment at the specified elevation and shall constitute a fully enclosed air- and weather-tight system. The isolation curb shall consist of an upper support rail with supply and return flexible connector supports on which the equipment and duct openings rest and a lower support curb which is attached to the roof structure, separated by freestanding, unhoused, laterally stable steel springs and lateral seismic and/or wind load restraints. The lower support curb shall have a minimum elevation of 14" (356 mm). Spring components shall be 2"/51 mm deflection, free-standing, unhoused, laterally stable steel springs. The weather seal shall run continuously around the perimeter of the curb and be joined in the field with one seam using a double-faced elastomeric adhesive. The weather seal shall be fastened to the wood nailer of the lower support curb using screws and an aluminum fascia strip.

- P. Horizontal Discharge Roof Curb: Steel with corrosion-protection coating, insulation, gasketing, and factory-installed wood nailer, and configured to convert from downflow to horizontal airflow; complying with NRCA standards; minimum height above roof of 26 inches.

2.3 MOTORS

- A. Comply with requirements in Division 23 Section "Motors."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances. Install according to ARI Guideline B.
- B. Curb Support: Install roof curb on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure rooftop air conditioners on curbs and coordinate roof penetrations and flashing with roof construction. Secure units to curb support with anchor bolts.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
 1. Gas Piping: Comply with applicable requirements in Division 23 Section "Fuel Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

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- C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 - 1. Install ducts to termination in roof curb.
 - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 - 3. Terminate return-air duct through roof structure and insulate space between roof and bottom of unit with 2-inch- thick, acoustic duct liner.
 - 4. Install normal-weight, 3000 psi, compressive strength (28-day) concrete mix inside roof curb, 4 inches thick. Concrete, formwork, and reinforcement are specified in Division 3.
- D. Electrical System Connections: Comply with applicable requirements in Division 16 Sections for power wiring, switches, and motor controls.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field quality-control tests and inspections and prepare test reports:
 - 1. After installing rooftop air conditioners and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove malfunctioning units, replace with new units, and retest as specified above.

3.4 ADJUSTING

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 237310

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SECTION 238229 – HYDRONIC PANEL RADIATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes flat-pipe steel radiators.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Indicate location and size of each field connection.
 - 4. Indicate location and arrangement of piping valves and specialties.
 - 5. Indicate location and arrangement of integral controls and other accessories.
- C. Color Samples for Verification: For each type of exposed finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural members, including wall construction, to which radiators will be attached.

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2. Method of attaching radiators to building structure.
 3. Penetrations of fire-rated wall and floor assemblies.
- B. Field quality-control reports.

1.5 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 FLAT-PIPE STEEL RADIATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hydro-Air Components Inc.
 2. Quincy Hydronic Technology Inc.
 3. Runtal North America, Inc.
 4. Zehnder Rittling
- B. Heating Elements: Steel, welded and formed into flat, square, steel header with minimum thickness of **0.109 inch**. Include threaded piping and air-vent connections. See Drawing Schedules for capacities and characteristics.
- C. Mounting:
1. **Wall brackets** with maximum spacing per manufacturer's guidelines.
 2. **Ceiling brackets** with maximum spacing per manufacturer's guidelines.
- D. **Finish:** Baked-enamel finish in manufacturer's **standard** color as selected by Architect.
- E. Accessories:
- a. Steel piping covers finished to match radiator finish.
 - b. Flexible Expansion Compensation Hoses
- F. Radiator Pressure Ratings
1. **High Pressure:** Tube Rated At **128 psi**; Max-Tested at **184 psi**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive radiators for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for hydronic-piping connections to verify actual locations before installation of radiators.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units level and plumb.
- B. Install expansion compensation hoses.
- C. Install piping covers.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 23 "Hydronic Piping" and Division 23 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect radiators and components to piping according to Division 23 "Hydronic Piping" and Division 23 "Hydronic Piping Specialties."
 - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
- C. Install control valves as required by Division 23 "Instrumentation and Control for HVAC."
- D. Install piping adjacent to radiators to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Appearance Test: After construction is completed, including painting, clean unit exposed surfaces.
 - a. Retouch any marred or scratched surfaces of factory-finish, using finish materials furnished by manufacturer.

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- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 238229

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SECTION 238236 - FINNED-TUBE RADIATION HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes **hydronic** finned-tube radiation heaters.

1.3 DESCRIPTION OF WORK

- A. Extent of terminal unit work is indicated by drawings and schedules, and by requirements of this section.
- B. Refer to other Division-23 sections for piping; ductwork; and testing, adjusting and balancing of finned-tube radiation units.
- C. Refer to Division-26 sections for the following work.
 - 1. Power supply wiring from power source to power connection on finned-tube radiation unit. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
- D. Provide the following electrical work as work of this section, complying with requirements of Division-26 sections:
 - 1. Control wiring between field-installed controls, indicating devices, and finned-tube radiation unit control panels.
 - a. Control wiring specified as work of Division-23 for Automatic Temperature Controls is work of that section.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

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3. Include details and dimensions of custom-fabricated enclosures.
 4. Indicate location and size of each field connection.
 5. Indicate location and arrangement of piping valves and specialties.
 6. Indicate location and arrangement of integral controls.
 7. Include enclosure joints, corner pieces, access doors, and other accessories.
 8. Include diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Color Samples for Initial Selection: For finned-tube radiation heaters with factory-applied color finishes.
- E. Color Samples for Verification: For each type of exposed finish.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Structural members, including wall construction, to which finned-tube radiation heaters will be attached.
 2. Method of attaching finned-tube radiation heaters to building structure.
 3. Penetrations of fire-rated wall and floor assemblies.
- B. Field quality-control reports.

1.6 OWNER SPECIFICATION COMPLIANCE

- A. All materials supplied for, and all installation methods used in this Section shall comply with both this Section AND USU's Published Design Standards, whichever is more stringent.

PART 2 - PRODUCTS

2.1 HOT-WATER FINNED-TUBE RADIATION HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Dunham-Bush, Inc.
 2. Edwards Engineering Corp.

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3. Modine.
 4. Slant/Fin Corp.
 5. Standard Fin-Pipe Radiator Corp.
 6. Sterling HVAC Products; Mestek, Inc.
 7. Ted Reed Thermal, Inc.
 8. Trane.
 9. Vulcan Radiator Co.
 10. Zehnder Rittling
- B. Performance Ratings: Rate finned-tube radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."
- A. Heating Elements: Copper tubing mechanically expanded into flanged collars to eliminate noise and insure durability and performance at scheduled ratings. Elements to consist of evenly spaced aluminum fins resting on element supports. One end of tube shall be belled. See Drawing Schedules for the following capacities and characteristics.
- B. Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.
- C. Floor-Mounted Pedestals: Conceal insulated piping at maximum 36-inch spacing. Pedestal-mounted back panel shall be solid panel matching front panel. Provide stainless-steel escutcheon for floor openings at pedestals.
- D. Support Brackets: Locate at maximum **36-inch** spacing to support front panel and element.
- E. Enclosure to be designed by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive finned-tube radiation heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for **hydronic-piping** connections to verify actual locations before installation of finned-tube radiation heaters.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 FINNED-TUBE RADIATION HEATER INSTALLATION

- A. General: Install finned tube radiation as indicated, and in accordance with manufacturer's installation instructions.
- B. Install units level and plumb.
- C. Install enclosure continuously around corners, using outside and inside corner fittings.
- D. Join sections with splice plates and filler pieces to provide continuous enclosure.
- E. Install access doors for access to valves.
- F. Locate finned tube radiation on outside walls as indicated. Install enclosure continuously from wall to wall.
- G. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.
- H. Install valves within reach of access door provided in enclosure.
- I. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.
- J. Install piping within pedestals for freestanding units.
- K. Center elements under windows. Where multiple windows occur over units, divide elements into equal segments centered under each window.
- L. Install end caps where units butt against walls. Install access panels centered in front of each shutoff valve, balancing cock, steam trap, or temperature control valve.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 23 "Hydronic Piping" and Division 23 Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot-water finned-tube radiation heaters and components to piping according to Division-23 "Hydronic Piping" and Division-23 Hydronic Piping Specialties."
 - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
- C. Install control valves as required by Division-23 "Instrumentation and Control for HVAC."
- D. Install piping adjacent to finned-tube radiation heaters to allow service and maintenance.
- E. Connect wiring according to Division-26 "Low-Voltage Electrical Power Conductors and Cables."

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- F. Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electric Installer.
- G. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 4. Appearance Test: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.
 - a. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 238236

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SECTION 260100 – GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide all items, articles, materials, equipment, operations and/or methods listed, mentioned, shown and/or scheduled on the drawings and/or in these specifications, including all labor, services, permits, fees, utility charges, and incidentals necessary and required to perform and complete the electrical work described in this Division. Apply for all permits early in the project to avoid problems due to code revisions.
- B. See the contract conditions (general and supplementary) and Division 1 for requirements concerning this Division including, but not limited to, submittals, shop drawings, substitution requests, change orders, maintenance manuals, record drawings, coordination, permits, record documents and guarantees.

1.3 RELATED WORK SPECIFIED ELSEWHERE:

- A. Mechanical equipment motors to be furnished under another Division but connected under this Division. Starters shall be provided by this Division, unless otherwise noted on the electrical drawings. Verify and coordinate all equipment locations and electrical characteristics with other trades involved in the work. Coordination shall be done prior to rough-in or ordering equipment.
- B. Control wiring for mechanical equipment beyond provisions shown on the Electrical Drawings shall be performed under another Division of the work.

1.4 COORDINATION:

- A. Contractor agrees that any discrepancies between the contract drawings and the contract specifications are found the higher cost option shall be used for bidding purposes and the discrepancy brought to the attention of the Engineer for clarification.
- B. Coordinate electrical connections to equipment:
 - 1. Refer to equipment manufacturer's shop drawings and written instructions. Provide all power and control wiring with associated raceways for complete operation.
 - 2. Where equipment is furnished with a cord and plug, provide receptacle to match equipment plug.
 - 3. Verify electrical requirements of equipment on nameplate and installation manual. Ensure that the electrical connections meet the requirements and notify Architect/Engineer of any discrepancies.

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4. Meet with equipment manufacturers' representatives to coordinate equipment installation and electrical connections.

1.5 QUALITY ASSURANCE:

- A. Do all work in accordance with regulations of serving electric utility, telephone utility, cable TV utility, National Electrical Code, state and local codes and amendments, National Fire Codes, and all other applicable codes.

1.6 PROJECT CONDITIONS:

- A. The Contractor shall inspect the job site prior to bidding and familiarize himself with existing conditions which will affect the work. Prior to start of work, obtain "As built", "Record", or other Drawings showing existing underground utilities.
- B. Electrical drawings are diagrammatic indicating approximate location of outlets, lighting fixtures, electrical equipment, etc. Consult the Architectural, Structural, and Mechanical Drawings to avoid conflicts with equipment, structural members, etc. When required make all deviations from Drawings to make the work conform to the building as constructed, and to related work of others. Minor relocations ordered prior to installation may be made without added cost to Owner.
- C. Call to the attention of the Architect any error, omission, conflict or discrepancy in Drawings and/or Specifications. Do not proceed with any questionable items of work until clarification of same has been made.
- D. Under no conditions are beams, girders, footings or columns to be cut for electrical items unless so shown on Drawings or written approval obtained from the Architect.
- E. Verify the physical dimensions of each item of electrical equipment to fit the available space and promptly notify the Architect prior to roughing-in if conflicts appear. Coordination of equipment to the available space and to the access routes through the construction shall be the Contractor's responsibility.

1.7 SUBMITTALS AND SHOP DRAWINGS:

- A. In addition to Section 13300, "Submittal Procedures", comply with the following.
- B. Prior to ordering materials and equipment, the Contractor shall provide submittals in original, searchable PDF format, bookmarked with Section#, Product Name, ID tag, etc. Scanned pages will not be acceptable. Materials and equipment of each specification section shall be complete prior to submittal. Partial submittals will be marked "Incomplete" and returned for resubmittal.
- C. List shall bear Contractor's stamp, signature or other means to show that he has inspected same and certified that submitted material is correct in regard to quantity, size, dimension, quality and is coordinated with the Contract Documents.
- D. See individual sections within this Division for products requiring submittal.

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- E. Each shop drawing submittal shall be prepared by the manufacturer, and shall clearly show manufacturer's name, catalog numbers, pictures, details, layout, type, size, rating, style, and all options identified in a permanent fashion. Specific items or options shall be permanently marked on sheets containing more than one option – do not rely on the Engineer to mark options.
- F. Large equipment drawings such as UPS systems, generators, transformers, switchboards, and similar large equipment shall include the size, weight, seismic rating, emissions data, elevation, and wiring diagrams in addition to the product data.
- G. Some sections of this Division may require shop drawings prepared on full size floor plans in AutoCAD or other CAD software. Where required, contact the Architect for the latest version of the floorplans and match the size and scale of the construction drawings. Drawings delivered to the contractor from the Architect/Engineer may not include addenda changes. Contractor shall only use floor plans for purposes of the construction on this job, and not for any other use or reuse. Add any required addenda items prior to finishing submittals.
- H. Provide complete materials (all materials) list at the beginning of each tabbed section showing "Specification Section", "Material Item", "Manufacturer's Name and Catalog Number", and all pertinent data.
- I. Provide samples where required in individual sections of this Division.
- J. Contractor agrees that Shop Drawing Submittals processed by the Architect are not Change Orders; that the purpose of Shop Drawing Submittals by the Contractor is to demonstrate to the Architect that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use.
- K. Contractor further agrees that if deviations, discrepancies or conflicts between Shop Drawings and Specifications are discovered either prior to or after Shop Drawing Submittals are processed by the Architect, the design Drawings and Specifications shall control and shall be followed.
- L. Delays caused by contractor's neglect to submit on materials and equipment in time for Architect/Engineer's review, correction, resubmittal(s), shipment and delivery to the jobsite shall be the responsibility of the contractor.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. All materials shall be new and bear manufacturer's name, model number, electrical characteristics and other identification. All equipment to be U.L. approved or listed by another testing agency approved by authorities having jurisdiction.

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- B. Material and equipment shall be standard product of manufacturer regularly engaged in production of similar material for at least five years (unless specifically exempted) and shall be manufacturer's latest design.
- C. If the description of a product is in conflict with the product as specified in the catalog number, the description shall generally take precedence. Contact the Architect for clarification if this occurs.
- D. All equipment shall be rated and certified for the appropriate seismic design category or seismic use group for the installed location.
- E. Provide access doors where required to maintain code-required access, or maintenance access, to equipment and wiring methods. Comply with Architectural division on Access Doors for requirements.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION METHODS:

- A. All items, articles, materials, and equipment specified under this Division shall be installed per the manufacturer's installation instructions. Where the manufacturer's instructions are in conflict with the directions provided elsewhere in this Contract, the Engineer shall be notified prior to beginning rough-in.
- B. Cutting or notching shall be kept to an absolute minimum and done when, and in a method approved by the Architect. Patch and correct finished surfaces damaged by electrical work.
- C. Relays, panels, cabinets and equipment shall be level and plumb and installed parallel with structural building lines. All equipment and enclosures shall fit neatly without gaps, openings, or distortions. Provide approved devices for closing all unused openings.
- D. Arrange circuit wiring as shown on the Drawings and do not alter or combine runs or homeruns without the specific approval of the Architect. Feeder runs shall not be recombined or altered.
- E. Contactors, transformers, starters and similar noise producing devices shall not be placed on walls which are common to occupied space.
- F. Ballasts, contactors, starters, transformers and like equipment which are found to be noticeably noisier than other similar equipment on the project will be deemed defective and shall be replaced.
- G. In general, the mounting heights shall be as noted on the Drawings, however, the Architectural Interior Elevations and drawing notes taking precedence. Where no heights are indicated, request clarification from the Architect. Consult the Architectural, Mechanical and Structural drawings to avoid conflicts prior to roughing-in and for exact locations.

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- H. Where raceways penetrate floors, ceilings, ducts, chases, and fire walls, provide fire stopping to maintain integrity of the fire assembly. Firestopping method shall be approved by the Architect and Code Authority having jurisdiction.
- I. Maintain the following minimum separations from voice and data cables. Power conduit - 12", transformers and motors - 40", fluorescent lighting - 12". Coordinate with the voice and data installer to assure these separations are met.
- J. All floor mounted equipment shall be installed and anchored to concrete structural or housekeeping pads.

3.3 SAFETY:

- A. The Engineer has not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to means, methods, techniques, sequences or procedures required for the contractor to perform the work.

3.4 EQUIPMENT CONNECTIONS:

- A. The location and method for connecting to each item of equipment shall be verified prior to roughing-in. The voltage and phase of each item of equipment shall be checked before connecting. Motor rotations shall be made in the proper direction. Pump motors are not to be test run until liquid is in the system and proper lubrication to all bearings in unit is checked.
- B. Conduit, wire and circuit breaker sizes for mechanical, elevator and similar equipment are based on the equipment ratings of one manufacturer. The equipment actually furnished may have entirely different electrical characteristics. Conduit, wire, circuit breakers, disconnects, etc. shall not be ordered or installed until exact electrical requirements are obtained. Responsibility for this coordination rests with the Contractor.

3.5 ACCESS DOORS:

- A. Provide access doors to maintain access to equipment, junction boxes, cable trays, open wiring systems and other equipment requiring access. Install access doors in locations approved by the Architect. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

3.6 PAINTING:

- A. All electrical equipment and conduit exposed in finished areas and on exterior walls are to be painted in color according to Architect's instructions.
- B. Contractor shall coordinate the timing of painting requirements.
- C. Refer to Architectural specifications for methods and materials.

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3.7 PROJECT RECORD DOCUMENTS:

A. Maintenance of Documents:

1. Maintain at Jobsite, One Record Copy of: Contract Drawings, Specifications, Addenda, Reviewed Shop Drawings, Change Orders, Other Modifications to Contract and Field Test Records.
2. Keep apart from documents used for construction.
3. Keep documents available at all times for inspection by Architect.

B. Recording:

1. Label each document "PROJECT RECORD."
2. Keep record documents current. Do not permanently conceal any work until required information has been recorded.
3. Contract Drawings, legibly mark to record actual construction; including but not limited to the following:
 - a. Depths of various elements; locations of underground items, with dimensions to building walls and corners; changes of dimensions and details; changes made by Addendum, Field Orders or Change Order.
 - b. Specifications and Addenda; legibly mark each Section to record changes made by Addendum, Field Order or Change Order.

C. As-Built Submittals:

1. At completion of project, transfer changes, addenda items, variations from drawings, exact routes of all feeders and service conduits, and locations of stubbed conduits to clean new prints and specifications which will be supplied by the Architect and deliver to the Architect as "As-reported Record" drawings. Include dimensions to all buried or concealed conduits to permanent structures.
2. Format for final as-built drawings shall be original PDF drawings, bookmarked per drawing sheet, marked up in PDF software such as Bluebeam. Scanned redline markups will not be acceptable.

D. Operation and Maintenance Manuals

1. At completion of project, prepare Operation and Maintenance Manuals with operation and Maintenance Data, contractors warranties, and copies of approved electrical permits. Include corrected copies of original submittals and shop drawings.
2. Manuals shall be in original, searchable PDF format, bookmarked with Section#, Product Name, ID tag, etc. Scanned pages will not be acceptable. Materials and equipment of each specification section shall be complete prior to

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submittal. Partial submittals will be marked "Incomplete" and returned for resubmittal.

3. See Division 1 for additional requirements.

3.8 WARRANTIES:

- A. Provide a minimum 1-year warranty on all electrical equipment, devices, labor, and work by Division 26 whether specified or not.
- B. Provide warranties greater than 1 year as specified in other sections where stated. The warranty requirement most stringent shall be used where conflicts arise.
- C. Provide copies of all warranties to the owner upon completion of the project.

3.9 COMPLETION:

- A. Complete each system as shown or specified herein and place in operation except where only roughing-in or partial systems are called for. Each system shall be tested and left in proper operation free of faults, shorts or unintentional grounds. Demonstrate system in the presence of the Architect, the Owner or their representative when requested.

3.10 FINAL OBSERVATION:

- A. Contractor shall submit written certification that:
 1. Contract Documents have been reviewed.
 2. Contractor has inspected Project for compliance with Contract Documents.
 3. Work has been completed in accordance with Contract Documents.
 4. Equipment and Systems have been tested and are operational.
 5. Project is completed and ready for final inspection.
- B. Architect/Engineer will make final inspection as soon as possible after receipt of Certification.
- C. If additional inspections are required because of the Contractor's failure to complete the deficiencies and errors prior to the second inspection, costs for the successive inspections will be back-charged to the Contractor by the Owner, who, in turn, will reimburse the Architect. Charges will be based as follows:
 1. Architect/Engineer time at current billing rates.
 2. Travel time, and all other expenses incurred in making inspections.

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- D. Contractor to provide one (1) journeyman, tools, meters, instruments and other test equipment required by Architect. Contractor to remove and replace trims, covers, fixtures, etc., for Architect to review and test materials, systems, methods and workmanship. (Example: Removing switchboard and panel covers to take voltage/amp readings, review connections and wire size, etc.)

END OF SECTION 260000

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

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. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electrical installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate electrical connections to equipment:
 - 1. Refer to equipment manufacturer's shop drawings and written instructions. Provide all power and control wiring with associated raceways for complete operation.
 - 2. Verify electrical requirements of equipment on nameplate and installation manual. Ensure that the electrical connections meet the requirements and notify Engineer of any discrepancies.
 - 3. Meet with equipment manufacturers representatives to coordinate equipment installation and electrical connections.
- C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".

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PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular, water tight sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. O-Z Gedney
 - e. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

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- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors **2 inches (50 mm)** above finished floor level.
- G. Size pipe sleeves to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for **1-inch (25-**

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mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals. Install water-tight assembly.
 - 1. Slope underground conduits away from building to prevent accumulated water from traveling down conduit into building.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Building wire rated 600 V and less.
 - 2. Metal-clad cable, Type MC, rated 600 V or less.
 - 3. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
 - 1. Division 26 Section "Medium-Voltage Cables" for single-conductor cables, cable splices, and terminations for electrical distribution systems with 601 to 35,000 V.

1.3 DEFINITIONS

- A. PV: Photovoltaic.
- B. RoHS: Restriction of Hazardous Substances.
- C. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Testing Agency Qualifications: Member company of NETA.

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1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 COORDINATION

- A. **MC Cable** shall not be used unless specifically approved by Facilities Management electrical engineer(s) through the University Project Manager in writing prior to bid.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. American Insulated Wire Corp.; a Leviton Company.
 2. Cerro Wire, LLC
 3. General Cable Corporation.
 4. Senator Wire & Cable Company.
 5. Southwire Company.
- C. Standards:
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. RoHS compliant.
 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Copper Conductors: complying with ASTM B 3 for bare annealed copper and with ASTM B 8 or ASTM B 496 (as applicable) for stranded conductors.
- E. Conductor Insulation: Comply with UL 83 and UL 44 for Types THHN-THWN-2, XHHW-2 CT rated, and SO.
- F. **Aluminum Conductors (NOT APPROVED ON PROJECT)**: Complying with ASTM B 800 and ASTM B 801.
 1. Shall not be used in 100-400 amp branch panelboard feeder applications only.
 2. Shall not be used for feeders below 100A or above 400A.
 3. Shall not be used for elevator feeders.
 4. Shall not be used for mechanical equipment feeders or branch circuits.
- G. Aluminum Conductor Insulation: Comply with UL 83 and UL 44 for Type XHHW-2.
- H. Cables installed in cable tray shall be rated for "Cable Tray" use, CT listed.
- I. Multiconductor Cable: Type SO with ground wire.

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2.2 METAL-CLAD CABLE, TYPE MC – NOT APPROVED ON PROJECT

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. [AFC Cable Systems, Inc.](#)
 - 2. [General Cable Technologies Corporation.](#)
 - 3. [Southwire Incorporated.](#)
 - 4. Cerro Wire, LLC
 - 5. Senator Wire & Cable Company
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits
 - 1. Single circuit and multicircuit with color-coded conductors.
 - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation:
 - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
- H. Armor: Steel, interlocked.

2.3 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Service and Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Panelboard Feeders 100A through 400A: Copper for feeders No. 1 AWG and larger. Stranded No. 1 AWG and larger.
- C. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- D. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
- B. Feeders: Type THHN-THWN-2, single conductors in raceway. Type XHHW-2 for aluminum feeders.
- C. Branch Circuits: Type THHN-THWN-2, single conductors in raceway.
- D. Multi-Wire Branch Circuits: Install no more than three circuits in a raceway, unless specifically shown otherwise.
- E. Neutral Conductors: Provide one neutral conductor for each phase conductor. Shared neutral conductors are not allowed.
- F. Minimum Branch Circuit Conductor Size: Provide the following minimum sizes for distances listed on 20A branch circuits to prevent excessive voltage drop. The circuit length shall be measured along the length of the conductor from the circuit breaker in the panelboard to the last device on the circuit. Increase raceway size to comply with conductor fill requirements of NFPA 70.
- G. Upsizing of Conductors
 - 1. Branch Circuit Voltage of 120V:
 - a. Circuit lengths less than 60 feet: Provide minimum #12 AWG conductor size.
 - b. Circuit lengths between 60 feet and 100 feet and/or where more than 3 current carrying conductors are installed in a single raceway: Provide minimum #10 AWG conductor size.
 - c. Circuit lengths between 100 feet and 150 feet: Provide minimum #8 AWG conductor size.
 - d. Circuit lengths greater than 150 feet: Perform voltage drop calculations and provide conductor size to keep branch circuit voltage drop less than 3% with a 15 amp load.

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- e. All lighting circuits feeding site lighting at 120V: Provide minimum #10 AWG conductor size for all conductors including equipment ground and upsize per voltage drop above 100 feet.
- 2. Branch Circuit Voltage of 277V:
 - a. Circuit lengths less than 150 feet: Provide minimum #12 AWG conductor size.
 - b. Circuit lengths between 150 feet and 240 feet: Provide minimum #10 AWG conductor size.
 - c. Circuit lengths between 240 feet and 380 feet: Provide minimum #8 AWG conductor size.
 - d. Circuit lengths greater than 380 feet: Perform voltage drop calculations and provide conductor size to keep branch circuit voltage drop less than 3% with a 15 amp load
 - e. All lighting circuits feeding site lighting at 277V: Provide minimum #10 AWG conductor size for all conductors including equipment ground and upsize per voltage drop above 240 feet.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.
- I. Class 1 Control Circuits: Type THHN-THWN-2, in raceway.
- J. Class 2 Control Circuits: Type THHN-THWN-2, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Install all conductors and cables in raceways per Division 26 Section, "Raceway and Boxes for Electrical Systems."
- B. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- C. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- D. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible. Paint to match conduits to surface in finished spaces.
- G. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

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- H. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Splices for No. 10 AWG and smaller shall be screw on type similar to Scotch or Ideal wing nut connectors.
 - 2. Crimp on splices designed to be used without wire stripping shall not be acceptable.
 - 3. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:

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1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
- D. Test Reports: Prepare a written report to record the following:
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Cables will be considered defective if they do not pass tests and inspections. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Overhead-line grounding.
 - 2. Underground distribution grounding.
 - 3. Ground bonding common with lightning protection system.
 - 4. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATION SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70 for grounding and bonding of electrical systems.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- 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.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Burndy; Part of Hubbell Electrical Systems.
 2. Dossert; AFL Telecommunications LLC.
 3. ERICO International Corporation.
 4. Fushi Copperweld Inc.
 5. Galvan Industries, Inc.; Electrical Products Division, LLC.
 6. Harger Lightning and Grounding.
 7. ILSCO.
 8. O-Z/Gedney; A Brand of the EGS Electrical Group.
 9. Robbins Lightning, Inc.
 10. Siemens Power Transmission & Distribution, Inc.
 11. VFC, Inc.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, **1/4 inch (6 mm)** in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; **1-5/8 inches (41 mm)** wide and **1/16 inch (1.6 mm)** thick.
 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; **1-5/8 inches (41 mm)** wide and **1/16 inch (1.6 mm)** thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, **1/4 by 4 inches (6.3 by 100 mm)** in cross section, with **9/32-inch (7.14-mm)** holes spaced **1-1/8 inches (28 mm)** apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
1. Pipe Connectors: Clamp type, sized for pipe.
- C. All lugs used in the building system shall be rated for copper only.

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- D. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- E. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- F. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- G. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- H. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- I. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- J. Conduit Hubs: Mechanical type, terminal with threaded hub.
- K. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- L. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- M. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- N. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- O. Straps: Solid copper, copper lugs. Rated for 600 A.
- P. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- Q. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Tin-plated aluminum.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; **3/4 inch by 10 feet (19 mm by 3 m)** in diameter.
- B. Ground Plates: **1/4 inch (6 mm)** thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install two bare tinned-copper conductors, No. 4/0 AWG minimum.
 - 1. Bury at least 36 inches (900 mm) below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
 - 3. Terminate Grounds at manholes and building.
- C. Isolated Grounding Conductors:
 - 1. Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
 - 2. Provide IG conductor in addition to the equipment grounding conductor in circuits and feeders serving IG devices and equipment.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- F. Conduits:
 - 1. All metallic conduits shall be properly grounded and bonded.
 - 2. For the following applications a separate code sized insulated ground conductor (in addition to the equipment grounding conductor), shall be terminated to an insulated/isolated ground bus:
 - a. Conduits serving a 208/120V panels or other feeders.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

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3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install two driven ground rods through manhole or handhole floor at opposite corners, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 4/0 AWG bare, finned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout. Install 4/0 bare copper conductor around entire manhole, ground all connections and ground rods to this conductor. Ground the duct bank ground conductors to this ground ring as well.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods at each pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground duct bank grounding conductors, encased electrode conductors, re-enforcing rebar of equipment pad and other available grounding electrodes.

3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.

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8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
-
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
 - D. HVAC Metallic Duct and Pipe Bonding within secure areas: Bond all metallic ductwork and metallic piping within each secure area with #10CU ground and connect to the nearest available ground bus within the secure room.
 - E. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
 - F. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
 - G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
 - H. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
 - I. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
 1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.
 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

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- J. Fence Grounding: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare, tinned copper, not less than No. 6 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.6 INSTALLATION

- A. Branch Circuits:
 - 1. Raceways used for single or multiple branch circuits shall include a code sized green insulated ground conductor.
 - 2. Circuits used for isolated ground outlets shall be run in separate raceways; or, shall have a separate green insulated ground conductor installed and tagged with identification at all outlet and junction boxes.
- B. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Ground Bonding Common with Existing Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- D. Ground Rods: Drive rods until tops are **2 inches (50 mm)** below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.
 - 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding

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- conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than **60 feet (18 m)** apart.
- I. Bonding of Exposed Structural Metal: Bond all exposed structural metal that is not grounded to the service equipment enclosure. The points of attachment of the bonding jumpers shall be accessible.
- J. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
1. Install tinned-copper conductor not less than No. 3/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring not less than **36 inches (900 mm)** from building's foundation.
- K. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of **20 feet (6 m)** of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than **20 feet (6 m)** long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.7 LABELING

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
 1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. 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.
- C. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Power Distribution Units or Panelboards Serving 120V or 208V equipment: 3 ohm(s).
 - 5. Substations and Pad-Mounted Equipment: 5 ohms.
 - 6. Manhole Grounds: 10 ohms.

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- G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Section 260548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Steel slotted support systems.
 - b. Clamps
 - c. Hangers
 - d. Sockets
 - e. Eye nuts
 - f. Fasteners
 - g. Anchors
 - h. Saddles
 - i. Brackets
 - 2. Include rated capacities and furnished specialties and accessories

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- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details for electrical hangers and support systems and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.
 - 5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

- C. Welding certificates.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Ductwork, piping, fittings, and supports.
 - 3. Structural members to which hangers and supports will be attached.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Items penetrating finished ceiling, including the following:
 - a. Luminaires
 - b. Air outlets and inlets
 - c. Speakers
 - d. Sprinklers
 - e. Access Panels
 - f. Projectors

- B. Seismic Qualification Certificates: For hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- C. Welding Certificates

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M
 - 2. AWS D1.2/D1.2M.

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1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
 - 2. Component Importance Factor: 1.5 raceways and equipment connected to an emergency/standby system; 1.0 for other raceways and equipment.
- C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 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. [Allied Tube & Conduit; a part of Atkore International.](#)
 - b. [B-line, an Eaton business.](#)
 - c. [ERICO International Corporation.](#)
 - d. [GS Metals Corp.](#)
 - e. [Thomas & Betts Corporation; A Member of the ABB Group](#)
 - f. [Unistrut; Part of Atkore International.](#)
 - g. Wesanco, Inc.
 - 2. Material: Galvanized steel
 - 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

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5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 7. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

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2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter:
 - 1. NECA 1
 - 2. NECA 101
 - 3. NECA 102
 - 4. NECA 105
 - 5. NECA 111
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be **1/4 inch (6 mm)** in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 50 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for **1-1/2-inch (38-mm)** and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus **200 lb (90 kg)**.

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- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts Beam, clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- E. Manhole Requirements:
 - 1. On manhole walls install a minimum of three, evenly spaced, flush cast-in horizontal unistrut cable supports. The lowest support shall be at 12" above the finished floor of the manhole, and the remaining two install at 3'-8" and 6'-4" above manhole floor.
 - 2. In addition, install vertical, surface mounted, unistrut cable supports over the cast-in horizontal supports. Vertical supports shall be installed in a minimum of four columns along each long wall and two columns along each short wall.
 - 3. Support each cable at unistrut cable supports with rubber cush-grips.
 - 4. Ring each cable around the manhole before terminating.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

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3.4 CONCRETE BASES

- A. Provide concrete bases for all floor mounted equipment including but not limited to: transformers, switchboards, generators, switches, cabinets, etc.
- B. Construct concrete bases of dimensions indicated but not less than **4 inches (100 mm)** larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- C. Use **3000-psi (20.7-MPa)**, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of **2.0 mils (0.05 mm)**.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Nonmetal conduits, tubing, and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Surface raceways.
 - 5. Boxes, enclosures, and cabinets.
 - 6. Handholes and boxes for exterior underground cabling.
- B. Related Sections include the following:
 - 1. Section Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. EMT: Electrical metallic tubing.
- C. FMC: Flexible metal conduit.
- D. GRC (RGS): Galvanized rigid steel conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. RNC: Rigid nonmetallic conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.
 - 2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.

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- b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.
- C. Raceway and fitting submittals - [Not required](#).

1.5 INFORMATION SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
- 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
- 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- D. Source quality-control test reports.

PART 2 - PRODUCTS

2.1 METAL CONDUIT, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. AFC Cable Systems, Inc.
 - 2. Alflex Inc.
 - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. Electri-Flex Co.
 - 6. Manhattan/CDT/Cole-Flex.
 - 7. Maverick Tube Corporation.
 - 8. O-Z Gedney; a unit of General Signal.
 - 9. Wheatland Tube Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: **0.040 inch (1 mm)**, minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. FMC: Comply with UL 1; Zinc-coated steel.
- I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- J. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: Comply with NEMA FB 1 and UL 514B; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT: Steel, set-screw or compression type.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, **0.040 inch (1 mm)**, with overlapping sleeves protecting threaded joints.
- K. Joint Compound for IMC, GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Heritage Plastics
 - 2. AFC Cable Systems, Inc.
 - 3. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 4. Arcco Corporation.
 - 5. CANTEX Inc.
 - 6. CertainTeed Corp.; Pipe & Plastics Group.
 - 7. Condux International, Inc.
 - 8. ElecSYS, Inc.
 - 9. Electri-Flex Co.
 - 10. Lamson & Sessions; Carlon Electrical Products.
 - 11. Manhattan/CDT/Cole-Flex.
 - 12. Niedax-Kleinhuis USA, Inc
 - 13. RACO; a Hubbell Company.
 - 14. Thomas & Betts Corporation.

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- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
 - 4. Basor Electric, Inc.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R as required, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

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- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems
 - b. MonoSystems, Inc
 - c. Wiremold / Legrand

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. Old Castle Enclosure Solutions.
 - 7. O-Z/Gedney; a unit of General Signal.
 - 8. RACO; a Hubbell Company.
 - 9. Robroy Industries, Inc.; Enclosure Division.
 - 10. Scott Fetzer Co.; Adalet Division.
 - 11. Spring City Electrical Manufacturing Company.
 - 12. Thomas & Betts Corporation.
 - 13. Walker Systems, Inc.; Wiremold Company (The).
 - 14. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.; double-gang, minimum 4-11/16" square boxes with single or double-gang mud ring appropriate for the device and wall plate.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Metal Floor Boxes:
 - 1. Material: sheet metal.
 - 2. Type: Fully adjustable.

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3. Shape: Rectangular.
 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- I. Minimum Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- J. Gangable boxes are allowed.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R as required by location, with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures: Fiberglass.
 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- L. Cabinets:
1. NEMA 250, Type 1 or Type 3R as required by location galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.
 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.
 - e. Oldcastle Precast Inc.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC" or "COMMUNICATIONS" as required by service type.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes **12 Inches Wide by 24 Inches Long** (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 1. Tests of materials shall be performed by an independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. **Outdoors:** Apply raceway products as specified below unless otherwise indicated:
 1. Exposed Conduit: GRC.
 2. Concealed Conduit, Aboveground: GRC.
 3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased where indicated.
 - a. Medium-Voltage Duct Banks: Concrete-encased.
 - b. Communication Duct Banks: Direct Bury.
 - c. Provide wrapped rigid steel conduit for the following conditions:
 - 1) Penetrations through foundation walls.
 - 2) Bends greater than 22 degrees.

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- 3) Stub ups, or where underground conduits otherwise become exposed.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
 6. Application of Handholes and Boxes for Underground Wiring:
 - a. Polymer concrete, SCTE 77, Tier 15 structural load rating.
- B. **Indoors:** Apply raceway products as specified below unless otherwise indicated:
1. Above 600V, All Locations: GRC.
 2. All Feeders and Service Entrance: EMT.
 3. Branch Circuits, Exposed, Not Subject to Physical Damage: EMT.
 4. Branch Circuits, Exposed and Subject to Physical Damage: Rigid steel conduit. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums
 5. Branch Circuits, Concealed in Ceilings and Interior Walls and Partitions: EMT.
 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 7. Damp or Wet Locations: GRC.
 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size:
1. **3/4-inch (21-mm)** trade size.
 2. 1-1/4-inch trade size for outdoor lighting.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

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- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds **120 deg F (49 deg C)**

3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least **6 inches (150 mm)** away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Properly ground raceways as specified in Division 26 Section "Grounding and Bonding for Electrical systems."
- H. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- I. Install no more than the equivalent of three 90-degree bends in any conduit run except for communication and control wiring conduits, for which fewer bends are allowed. Support within **12 inches (300 mm)** of changes in direction.
- J. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- K. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- L. Support conduit within **12 inches ((300 mm))** of enclosures to which attached.
- M. Raceways Embedded in Slabs on Grade (**NOT APPROVED ON PROJECT**):
 - 1. Run conduit larger than **1-inch (27-mm)** trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement,

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- place conduit close to slab support. Secure raceways to reinforcement at maximum **10-foot ((3-m))** intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 3. Arrange raceways to keep a minimum of **1 inch (25 mm)** of concrete cover in all directions.
 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 5. Change from PVC to GRC before rising above floor.
- N. Do not install conduits embedded in elevated slabs.
- O. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for raceways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- P. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- Q. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- R. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- S. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to **1-1/4-inch (35mm)** trade size and insulated throat metal bushings on **1-1/2-inch (41-mm)** trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- T. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- U. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- V. Cut conduit perpendicular to the length. For conduits **2-inch (53-mm)** trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- W. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than **1200-lb (544-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- X. Surface Raceways:
1. Install surface raceway with a minimum **2-inch (50-mm)** radius control at bend points.

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2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding **48 inches (1200 mm)** and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- Y. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- Z. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service raceway enters a building or structure.
 3. Conduit extending from interior to exterior of building.
 4. Conduit extending into pressurized duct and equipment.
 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 6. Where otherwise required by NFPA 70.
- AA. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- BB. Expansion-Joint Fittings:
1. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed **100 deg F (55 deg C)** and that has straight-run length that exceeds **100 feet (30 m)**.
 2. Install fitting(s) that provide expansion and contraction for at least **0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C)** of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least **0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C)** of temperature change for metal conduits.
 3. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- CC. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of **72 inches (1830 mm)** of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.

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- DD. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, comply with ADA requirements and refer to Architectural elevations.
- EE. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- FF. Boxes in stud walls: Do not install boxes back to back in stud walls. Allow one stud separation or 24" minimum. Where this is not possible, then provide boxes with UL-listed fire rated and sound rated wrapping.
- GG. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- HH. Locate boxes so that cover or plate will not span different building finishes.
- II. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- JJ. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- KK. Set metal floor boxes level and flush with finished floor surface.
- LL. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- MM. Conduits installed with wrinkles or kinks or otherwise in an unprofessional manner shall be replaced by the contractor at no additional cost to the owner.

3.3 INSTALLATION OF RACEWAYS FOR LOW VOLTAGE SYSTEMS

- A. All conduits extending from the floor should extend 1-3" AFF and no more than 2" off any wall.
- B. Conduit rows should not exceed two deep
- C. Conduits that enter a Telecomm Room (TR) should terminate near the corners to allow for proper racking.
- D. All pathways must not exceed 295' from the TR to the com/outlet must not have a bend over 90 degrees or an aggregate of bends in excess of 180 degrees between pull points.
- E. Conduit segments will not exceed 100' without a pull point.
- F. Conduit runs should be limited to less than 150'
- G. All conduits should be equipped with a pull cord that has a minimum rating of 200lbs.

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- H. A minimum of 1" conduit is required for all Voice/Data locations
- I. Wireless locations should be mounted directly to the ceiling or T-bar. Wall mount locations will be approved on a case by case basis in written form.
- J. Pathways should be installed at least 3" of clear vertical space above the ceiling tiles and T-bars to ensure accessibility, and should at no point rest or be supported by any component of the suspended ceiling
- K. J-hook supports are not acceptable
- L. Underground entrances should not have more than 2 - 90 degree bends between pull points
- M. All comm. raceways will have a pull rope installed during initial installation (200lb)

3.4 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than **6 inches (150 mm)** in nominal diameter.
 - 2. Install backfill as specified in Division 31 Section "Earth Moving."
 - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within **12 inches (300 mm)** of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
 - 4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with **3 inches (75 mm)** of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of **60 inches (1500 mm)** from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
 - 5. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape with detectable metal strip directly above line at **6 to 8 inches (150 to 200 mm)** below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds **16 inches (400 mm)** overall.

3.5 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

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- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install handholes and boxes with bottom below the frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.7 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.8 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes steel cable trays and accessories.

1.3 SUBMITTALS

- A. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
 - 2. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
 - a. Design Calculations: Calculate requirements for selecting seismic restraints.
 - b. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.
- C. Coordination Drawings: Floor plans and sections, drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements. Show the following:
 - 1. Vertical and horizontal offsets and transitions.
 - 2. Clearances for access above and to side of cable trays.
 - 3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For cable trays to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

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- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store indoors to prevent water or other foreign materials from staining or adhering to cable tray. Unpack and dry wet materials before storage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Chalfant Manufacturing Company.
 - 2. Cooper B-Line, Inc.
 - 3. Cablofil (Legrand)
 - 4. GS Metals Corp.; GLOBETRAY Products.
 - 5. MONO-SYSTEMS, Inc.
 - 6. MPHusky.
 - 7. PW Industries.

2.2 MATERIALS AND FINISHES

- A. Wire Mesh Cable Trays, Fittings, and Accessories: Steel wire mesh/basket type, complying with NEMA VE 1.
 - 1. Carbon steel ASTM A510 grade 1008, electroplated zinc complying with ASTM B633.
- B. Sizes and Configurations: Refer to Drawings for specific requirements for types, materials, sizes, and configurations. Where not indicated, provide the following size:
 - 1. 18" wide x 4" deep.
- C. Provide trapeze style support for cable trays.

2.3 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray. Provide factory fittings, elbows, 90s, sweeps, waterfalls, etc. No field modified fittings.
- B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.
- C. Dividers: Provide factory cable tray dividers including all fittings and connectors compatible with cable tray.
 - 1. All cable trays shall have dividers included to partition the cable tray into two separate sections.

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2.4 SOURCE QUALITY CONTROL

- A. Perform design and production tests according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.
- B. Drawings show general cable tray layout and do not detail changes in elevation or offsets required to maneuver around structure and work of other trades. Coordinate cable tray layout with other construction elements and include transitions, offsets and changes in elevation.
- C. Remove burrs and sharp edges from cable trays.
- D. Install dividers in all cable trays following manufacturer instructions.
- E. Fasten cable tray supports to building structure and install seismic restraints.
 - 1. Design each fastener and support to carry load indicated by seismic requirements and to comply with seismic-restraint details according to Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
 - 2. Place supports so that spans do not exceed cable tray ratings with installed weight load.
 - 3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
 - 4. Support bus assembly to prevent twisting from eccentric loading.
 - 5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
 - 6. Locate and install supports according to NEMA VE 1.
- F. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.
- G. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA VE 1. Space connectors and set gaps according to applicable standard.
- H. Make changes in direction and elevation using standard fittings.
- I. Make cable tray connections using standard fittings.
- J. Cable Trays Above Accessible Ceilings:
 - 1. Locate bottom of cable tray between 3" - 12" above accessible ceiling tile such that ceiling tile can be removed and cable tray can be accessed.

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2. Locate cable tray at least 3" below perpendicular piping and duct work crossing so that top of tray can be accessed.
 - a. Maintain 12" minimum clearance above cable tray for its entire length except for direct crossings, but should impact no more than 4ft of the cable tray.
 3. Maintain at least 12" separation from lighting fixtures.
 4. Maintain at least 3" separation from branch circuits, and 18" separation from feeders.
 5. Maintain at least 18" of side clearance for cable tray for access into cable tray.
- K. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- L. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- M. Workspace: Install cable trays with enough space to permit access for installing cables.
- N. Grounding and Bonding: bond cable tray to telecomm grounding system. Each conduit shall be bonded to cable tray with #8 cable for all low voltage cabling systems utilizing the cable tray.

3.2 CABLE INSTALLATION

- A. Install cables only when cable tray installation has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. On vertical runs, fasten cables to tray every 18 inches (457 mm). Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- D. In existing construction, remove inactive or dead cables from cable tray.
- E. The inside of a cable tray must be free of burrs, sharp edges, or projections that can damage the cable during installation
- F. Elevation changes and offsets must be kept to a minimum
- G. Tray should extend at least 1" into the TR then waterfall to 8' to accommodate internal racking
- H. When cable tray is used, conduit should extend from the telecom outlet located in the work area, directly to the cable tray.

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- I. Trays should be supported every 5' and within 24" on each side of a fitting (unless otherwise noted by the manufacture)
- J. All metallic cable trays must be grounded, marked and all sections bonded in accordance with applicable codes, standards and regulations
- K. Pathways should be kept in common areas to avoid future maintenance occurring in private work areas.
- L. Trays should be sized to be at no more than 40% fill.

3.3 CONNECTIONS

- A. Ground cable trays according to manufacturer's written instructions.
 1. Bond discontinuous sections of cable trays together so that cable tray is electrically continuous.
 2. Bond cable trays to sections of metal raceways that are part of the cable pathway system.

3.4 FIELD QUALITY CONTROL

- A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:
 1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
 2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
 3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
 4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
 5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorqued in suspect areas.
 6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

3.5 PROTECTION

- A. Protect installed cable trays.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
 2. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

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END OF SECTION 260536

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

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2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; **0.0239-inch (0.6-mm)** minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
 1. Material: Galvanized sheet steel.
 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than **50 inches (1270 mm)** and with no side larger than **16 inches (400 mm)**, thickness shall be **0.052 inch (1.3 mm)**.
 - b. For sleeve cross-section rectangle perimeter **50 inches (1270 mm)** or more and one or more sides larger than **16 inches (400 mm)**, thickness shall be **0.138 inch (3.5 mm)**.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel.
 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

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2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

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4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 5. Install sleeves for floor penetrations. Extend sleeves installed in floors **2 inches (50 mm)** above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for **1-inch (25-mm)** annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for **1-inch (25-mm)** annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

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SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Spring isolators.
 - 3. Restrained spring isolators.
 - 4. Channel support systems.
 - 5. Restraint cables.
 - 6. Hanger rod stiffeners.
 - 7. Anchorage bushings and washers.
- B. Related Sections include the following:
 - 1. Division 26 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading: Refer to project Structural Drawings and Specifications for the following, as defined in the IBC:
 - 1. Site Class: As indicated in structural project documents
 - 2. Assigned Seismic Use Group or Building Category.
 - a. Component Response Modification Factor: As indicated in structural project documents
 - b. Component Amplification Factor: As indicated in structural project documents
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): As indicated in structural project documents
 - 4. Design Spectral Response Acceleration at 1.0-Second Period: As indicated in structural project documents
- B. Component Importance Factor:
 - 1. In order to identify systems requiring seismic restraint and to define those from which restraints may be excluded, utility components are assigned an ASCE 7 Importance Factor (I_p) on the basis of the following:
 - a. $I_p = 1.5$

- 1) essential facilities required for post earthquake recovery – all components required for the continued operation of the facility.
 - 2) Life-safety components which are required to function after a seismic event including all equipment feeding and connected to the life safety branch of the electrical system.
 - 3) All equipment feeding and connected to the stand-by branch of the electrical system.
- b. $I_p = 1.0$ All other components.

1.5 SUBMITTALS

- A. Product Data: For the following:
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details 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. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
 - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.
 2. Provide Seismic Design Force calculations per ASCE 7- [02, Formulas 9.6.1.3-1 thru 9.6.1.3-3] [05, Formulas 13.3-1 thru 13.3-3].
 3. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
 4. Field-fabricated supports.
 5. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

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- c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Deferred Submittals for DFCM shall be as required by IBC 106.3.4.2.
 - 1. Deferred submittals of seismic restraint of nonstructural components must be submitted to the DFCM Building Official a minimum of two weeks prior to the planned installation in order to allow for plan review and forwarding to inspectors. In the event that the submittal is deficient additional time may become necessary.
 - 2. No deferred submittal element shall be installed until DFCM approval has been received.
 - 3. If seismic restraints of nonstructural components are installed prior to receiving DFCM approval they shall not be covered or concealed until plan review and inspection approval. Further, installers are proceeding at their own risk until plan review and inspection approval occurs.
 - 4. Deferred Submittals are required for:
 - a. Electrical distribution equipment (switchgear, panelboards, transformers, MCC's etc.).
 - b. Conduit racks.
 - c. Cable trays.
 - d. Lighting Concrete Pole Bases.
- D. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- E. Welding certificates.
- F. Qualification Data: For professional engineer.
- G. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing seismic engineering services, including the design of seismic restraints, that are similar to those indicated for this Project.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

- D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ace Mountings Co., Inc.
 2. Amber/Booth Company, Inc.
 3. California Dynamics Corporation.
 4. Isolation Technology, Inc.
 5. Kinetics Noise Control.
 6. Mason Industries.
 7. Vibration Eliminator Co., Inc.
 8. Vibration Isolation.
 9. Vibration Mountings & Controls, Inc.
- B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene.
- C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to **1/4-inch- (6-mm-)** thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to **500 psig (3447 kPa)**.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to **1/4-inch- (6-mm-)** thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti Inc.
 - 5. ISAT.
 - 6. Loos & Co.; Seismic Earthquake Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: [Steel tube or steel slotted-support-system sleeve with internally bolted connections] [Reinforcing steel angle clamped] to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or

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hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 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. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 - 1. Install restrained isolators on electrical equipment.
 - 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

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3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:
 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 ADJUSTING

- A. Adjust isolators after isolated equipment 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 active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

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3.6 SPECIAL INSPECTION

- A. Per the requirements of ASCE 7, the building owner will employ a special inspector(s) to observe the construction of all Designated Seismic Systems in accordance with the Quality Assurance Plan.

END OF SECTION 260548

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Not Required.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.

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- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at More Than 600 V (where exposed):
 - 1. White letters on painted red raceways.
 - 2. Legend: "DANGER HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high letters on 20-inch (500-mm) centers.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- D. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.4 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.

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2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 4. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 5. Overall Thickness: **5 mils (0.125 mm)**.
 6. Foil Core Thickness: **0.35 mil (0.00889 mm)**.
 7. Weight: **28 lb/1000 sq. ft. (13.7 kg/100 sq. m)**.
 8. **3-inch (75-mm)** Tensile According to ASTM D 882: **70 lbf (311.3 N)**, and **4600 psi (31.7 MPa)**.
- B. Color and Printing:
1. Comply with ANSI Z535.1 through ANSI Z535.5.
 2. Inscriptions for Red-Colored Tapes: **ELECTRIC LINE, HIGH VOLTAGE,**.
 3. Inscriptions for Orange-Colored Tapes: **TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.**

2.5 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 2. **1/4-inch (6.4-mm)** grommets in corners for mounting.
 3. Nominal size, **7 by 10 inches (180 by 250 mm)**.
- D. Metal-Backed, Butyrate Warning Signs:
1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with **0.0396-inch (1-mm)** galvanized-steel backing; and with colors, legend, and size required for application.
 2. **1/4-inch (6.4-mm)** grommets in corners for mounting.
 3. Nominal size, **10 by 14 inches (250 by 360 mm)**.
- E. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR **48 INCHES (1200 MM)**."

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2.6 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum **1/16 inch (1.6 mm)** thick for signs up to **20 sq. inches (129 sq. cm)** and **1/8 inch (3.2 mm)** thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch (10 mm)**.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch (10 mm)**. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.7 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be **3/8 inch (10 mm)**.
- B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be **1 inch (25 mm)**.

2.8 CABLE TIES

- A. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
 - 1. Minimum Width: **3/16 inch (5 mm)**.
 - 2. Tensile Strength at **73 deg F (23 deg C)**, According to ASTM D 638: **7000 psi (48.2 MPa)**.
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: **Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C)**.

2.9 Color: Black. MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

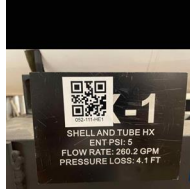
2.10 USU Required Equipment Labeling:

- A. All equipment needing maintenance shall be engraved with USU's numbering system as outlined in the specification. USU will assist where needed in tagging of equipment. This will be handled through the PM of the project in conjunction with the Engineering Technician Lead and PM coordinator.
 - 1. USU numbering system is **Building#-Room#-Equipment**. Example: **006-100-AHU1** Note that building shall be three numbers, and, if needed, a letter.

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2. On engraved equipment tags, a 2"x2" blank area in the upper left corner of the equipment tag shall be provided to allow for USU provided QR code information.
3. The image below is a covered-up equipment number due to lack of coordination with USU and failure to meet USU asset tagging requirements. USU requires a 2" x 2" area left blank for our QR tagging efforts.



- a.
- B. QR codes for our system will be provided by USU to the contractor when the contractor-provided, engraved, plastic tags are ready for installation. Contractor shall coordinate installation of tags with USU project manager and Engineering Technician Lead.
- C. USU will supply the team with an Excel export spreadsheet (**GREEN fields are required**) to be filled out as thoroughly as possible with USU's assistance as needed. Questions shall be submitted to the USU project manager.
- D. Review additional requirements required for O&M manuals in specification 017823 and for USU excel spreadsheet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at **50-foot (15-m)** maximum intervals in straight runs, and at **25-foot (7.6-m)** maximum intervals in congested areas.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

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- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at **6 to 8 inches (150 to 200 mm)** below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds **16 inches (400 mm)** overall.
- J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil **4-inch- (100-mm-)** wide black stripes on **10-inch (250-mm)** centers over orange background that extends full length of raceway or duct and is **12 inches (300 mm)** wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with **3-inch- (75-mm-)** high black letters on **20-inch (500-mm)** centers. Stop stripes at legends. Apply to the following finished surfaces:
 - 1. Floor surface directly above conduits running beneath and within **12 inches (300 mm)** of a floor that is in contact with earth or is framed above unexcavated space.
 - 2. Wall surfaces directly external to raceways concealed within wall.
 - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Snap-around labels. Install labels at **30-foot (10-m)** maximum intervals.
- C. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
 - 3. UPS.
- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors. Color coding is based on clockwise rotation.
 - a. Conductors No. 6 AWG and below shall be color coded with colored insulation. Larger sizes may be identified by field-applied color-coding conductor tape.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral: White.

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- 5) Neutral A: White w/ Black Stripe.
 - 6) Neutral B: White w/ Red Stripe.
 - 7) Neutral C: White w/ Blue Stripe.
 - 8) Ground: Green.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral: Grey.
 - 5) Neutral A: Gray w/ Brown Stripe.
 - 6) Neutral A: Gray w/ Orange Stripe.
 - 7) Neutral A: Gray w/ Yellow Stripe.
 - 8) Ground: Green.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of **6 inches (150 mm)** from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- E. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use write-on tags.
1. For HV cable in each manhole or transformer vault via a permanently installed metal tag and colored tape. Tag cables with feeder number and identification at all visible points on phase B. Phasing will be consistent with the rest of the system and shall be marked as follows:
 - a. Phase 1: Black.
 - b. Phase 2: Red.
 - c. Phase 3: Blue.
- F. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- J. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70

- and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.
 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- L. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- M. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum **3/8-inch- (10-mm-)** high letters for emergency instructions at equipment used for power transfer.
- N. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with **1/2-inch- (13-mm-)** high letters on **1-1/2-inch- (38-mm-)** high label; where two lines of text are required, use labels **2 inches (50 mm)** high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label stenciled legend **4 inches (100 mm)** high.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 2. Equipment to Be Labeled:
 - a. Enclosures and electrical cabinets.
 - b. Access doors and panels for concealed electrical items.
 - c. Switchgear.
 - d. Switchboards.
 - e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - f. Substations.
 - g. Emergency system boxes and enclosures.
 - h. Enclosed switches.

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- i. Enclosed circuit breakers.
- j. Push-button stations.
- k. Power transfer equipment.
- l. Contactors.
- m. Monitoring and control equipment.

3.3 IDENTIFICATION REQUIREMENTS FOR MEDIUM-VOLTAGE INSTALLATIONS

A. Labeling & ID Tags

1. General Requirements

- a. install appropriate labels and tags throughout the project's electrical system as directed by USU electric shop.
- b. The purpose of the labels and tags is to provide clear indications of the function of each item, the loads served, routing information, etc., for primary and secondary elements comprising the electrical system.

2. Permanently Engraved Lamicoid Nameplates

- a. Specify permanently engraved nameplates, labels, or ID tags for a master nameplate, also for manholes, distribution equipment, devices, etc.
- b. Lamicoid nameplates shall be three-ply plastic, 1/16 inch thick. Letters shall be formed by engraving into the outer colored ply, exposing the white or black center-ply. Lettering shall be a minimum of 5/8 inch high, except for MV cable.

END OF SECTION 260553

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SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE AND ARC-FLASH STUDY

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 a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.
- B. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
 - 1. Study results shall be used to determine coordination of series-rated devices.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and equipment evaluation reports.

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3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
4. Arc-flash study input data, including completed computer program input data sheets.
5. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
- B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1. Include the following:
 - a. The following parts from the Protective Device Coordination Study Report:
 - 1) SKM Model.
 - 2) One-line diagram.
 - 3) Protective device coordination study.
 - 4) Time-current coordination curves.
 - b. Power system data.

1.7 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

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1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- C. Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Software Developers: Subject to compliance with requirements, provide software by the following:
 1. SKM Systems Analysis, Inc.
- B. Comply with IEEE 1584 and NFPA 70E.
- C. Comply with IEEE 242 and IEEE 399.
- D. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- E. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
 1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENT

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope.

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- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Cable size and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center and panelboard designations.

- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output:
 - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

- F. Incident Energy and Flash Protection Boundary Calculations:
 - 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Working distance.
 - 6. Incident energy.
 - 7. Hazard risk category.
 - 8. Recommendations for arc-flash energy reduction.

- G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Cable size and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.

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4. Motor and generator designations and kVA ratings.
 5. Switchgear, switchboard, motor-control center, and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study:
1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Equivalent impedance.
 2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Calculated asymmetrical fault currents:
 - 1) Based on fault-point X/R ratio.
 - 2) Based on calculated symmetrical value multiplied by 1.6.
 - 3) Based on calculated symmetrical value multiplied by 2.7.
 3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- F. Protective Device Coordination Study:
1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
 - a. Phase and Ground Relays:
 - 1) Device tag.
 - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
 - 3) Recommendations on improved relaying systems, if applicable.

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- b. Circuit Breakers:
 - 1) Adjustable pickups and time delays (long time, short time, ground).
 - 2) Adjustable time-current characteristic.
 - 3) Adjustable instantaneous pickup.
 - 4) Recommendations on improved trip systems, if applicable.
 - c. Fuses: Show current rating, voltage, and class.
- G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
- 1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
 - 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
 - 3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
 - 4. Plot the following listed characteristic curves, as applicable:
 - a. Power utility's overcurrent protective device.
 - b. Medium-voltage equipment overcurrent relays.
 - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
 - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 - f. Cables and conductors damage curves.
 - g. Ground-fault protective devices.
 - h. Motor-starting characteristics and motor damage points.
 - i. Generator short-circuit decrement curve and generator damage point.
 - j. The largest feeder circuit breaker in each motor-control center and panelboard.
 - 5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.
 - 6. Provide adequate time margins between device characteristics such that selective operation is achieved.
 - 7. Comments and recommendations for system improvements.

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2.4 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch (76-by-127-mm) thermal transfer label of high-adhesion polyester for each work location included in the analysis.
- B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1. Location designation.
 - 2. Nominal voltage.
 - 3. Flash protection boundary.
 - 4. Hazard risk category.
 - 5. Incident energy.
 - 6. Working distance.
 - 7. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
 - 2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

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- G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
 - 1. Electric utility's supply termination point.
 - 2. Switchgear.
 - 3. Unit substation primary and secondary terminals.
 - 4. Low-voltage switchgear.
 - 5. Motor-control centers.
 - 6. Standby generators and automatic transfer switches.
 - 7. Branch circuit panelboards.

3.3 PROTECTIVE DEVICE COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. The study shall be based on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
 - 2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

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- H. Motor Protection:
 - 1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
 - 2. Select protection for motors served at voltages more than 600 V according to IEEE 620.
- I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.
- K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
 - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
 - 1. Electric utility's supply termination point.
 - 2. Switchgear.
 - 3. Unit substation primary and secondary terminals.
 - 4. Low-voltage switchgear.
 - 5. Motor-control centers.
 - 6. Standby generators and automatic transfer switches.
 - 7. Branch circuit panelboards.
- M. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 - 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
 - 3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.

3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

- A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:

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1. Determine load-flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
2. Determine load-flow and voltage drop based on 80 percent of the design capacity of the load buses.
3. Prepare the load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.5 POWER SYSTEM DATA

A. Obtain all data necessary for the analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Gather and tabulate the following input data to support coordination study. Comply with recommendations in IEEE 1584, IEEE 241, IEEE 551, and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
5. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
6. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
8. Motor horsepower and NEMA MG 1 code letter designation.
9. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
10. Short-circuit current at each system bus, three phase and line-to-ground.
11. Full-load current of all loads.
12. Voltage level at each bus.
13. Maximum demands from service meters.

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14. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.
15. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.
 - k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.6 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

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3.7 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Use the short-circuit study output and the field-verified settings of the overcurrent devices.
- C. Calculate maximum and minimum contributions of fault-current size.
 - 1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
 - 2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except 240-V ac and 208-V ac systems fed from transformers less than 125 kVA.
- F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond three to five cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
 - 1. When the circuit breaker is in a separate enclosure.
 - 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.8 LABELING

- A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:

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1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Control panel.

3.9 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.10 DEMONSTRATION

- A. Engage the Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.
- B. Engage the Study Specialist to train Owner's maintenance personnel in the following:
 1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.
 2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
 3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260574

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SECTION 260923 - DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Digital Lighting Load Controls
 - 2. Relay Panels
 - 3. Emergency Lighting Control (if applicable)
- B. Related Sections:
 - 1. Section 262726 - Wiring Devices Receptacles
 - 2. Section 265113 – Interior Lighting Fixtures, Lamps, and Ballasts Fluorescent electronic dimming ballasts.
- C. Control Intent – Control Intent includes, but is not limited to:
 - 1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
 - 2. Initial sensor and switching zones
 - 3. Initial time switch settings
 - 4. Emergency Lighting control (if applicable)

1.2 REFERENCES

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) (www.ansi.org and www.ieee.org)
- B. International Electrotechnical Commission (IEC) (www.iec.ch)
- C. International Organization for Standardization (ISO) (www.iso.ch):
- D. National Electrical Manufacturers Association (NEMA) (www.nema.org)
- E. WD1 (R2005) - General Color Requirements for Wiring Devices.
- F. Underwriters Laboratories, Inc. (UL) (www.ul.com):
 - 1. 508 – Industrial Controls
 - 2. 916 – Energy Management Equipment
 - 3. 924 – Emergency Lighting
- G. Underwriter Laboratories of Canada (ULC) (www.ulc.ca)

1.3 SYSTEM DESCRIPTION & OPERATION

- A. The Lighting Control and Automation system as defined under this section covers the following equipment:
 - 1. Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
 - 2. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.
 - 3. Digital Fixture Controllers – Self-configuring, digitally addressable one relay fixture-integrated controllers for on/off/0-10V dimming control.

4. Digital Occupancy Sensors – Self-configuring, digitally addressable, calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
5. Digital Switches – Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.
6. Handheld remotes for personal control – On/Off, dimming and scene remotes for control using infrared (IR) communications. Remote may be configured in the field to control selected loads or scenes without special tools.
7. Digital Daylighting Sensors – Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications for daylight harvesting using switching, bi-level, tri-level or dimming control.
8. Configuration Tools – Handheld remote for room configuration and relay panel programming provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away.
9. Digital Lighting Management (DLM) segment network – Linear topology, BACnet MS/TP network (1.5 twisted pair, shielded) to connect multiple DLM local networks for centralized control.
10. Network Bridge – Provides BACnet MS/TP-compliant digital networked communication between rooms, panels and the Segment Manager or building automation system (BAS) and automatically creates BACnet objects representative of connected devices.
11. Segment Manager – BACnet MS/TP-based controller with web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting.
12. Programming and Configuration Software – Optional PC-native application capable of accessing DLM control parameters within a room, for the local network, via a USB adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication.
13. Digital Lighting Management Relay Panel and Zone Controller – Provides up to 8, 24, or 48 mechanically latching relays. Relays include a manual override and a single push-on connector for easy installation or removal from the panel. Panel accepts program changes from handheld configuration tool for date and time, location, holidays, event scheduling, button binding and group programming. Provides BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS). Zero relay Zone Controller primarily supports Digital Fixture Controller applications.
14. Emergency Lighting Control Unit (ELCU) – Allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building

1.4 LIGHTING CONTROL APPLICATIONS

- A. Unless relevant provisions of the applicable local energy codes are more stringent, provide a minimum application of lighting controls as follows:
 1. Space Control Requirements – Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is

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desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.

2. Daylit Areas – Provide daylight-responsive automatic control in all spaces (conditioned or unconditioned) where daylight contribution is available as defined by relevant local building energy code:
 - a. All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylit zones.
 - b. Daytime setpoints for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with relevant local building energy codes.
 - c. Multiple-level switched daylight harvesting controls may be utilized for areas marked on drawings.
 - d. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.
3. Conference, meeting, training, auditoriums, and multipurpose rooms shall have controls that allow for independent control of each local control zone. Rooms larger than 300 square feet shall instead have at least four preset lighting scenes unless otherwise specified. Occupancy / vacancy sensors shall be provided to turn off all lighting in the space. Spaces with up to four moveable walls shall include controls that can be reconfigured when the room is partitioned.

1.5 SUBMITTALS

- A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.
- B. Shop Drawings:
 1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
 2. Show exact location of all digital devices, including at minimum sensors, load controllers, and switches for each area on reflected ceiling plans. (Contractor must provide AutoCAD format reflected ceiling plans.)
 3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
 4. Network riser diagram including floor and building level details. Include network cable specification and end-of-line termination details, if required. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.
- C. Product Data: Catalog sheets, specifications and installation instructions.
- D. Include data for each device which:
 1. Indicates where sensor is proposed to be installed.
 2. Prove that the sensor is suitable for the proposed application.

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1.6 QUALITY ASSURANCE

1.7 Manufacturer: Minimum 10 years experience in manufacture of lighting controls.

1.8 PROJECT CONDITIONS

- A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
1. Ambient temperature: 0° to 40° C (32° to 104° F).
 2. Relative humidity: Maximum 90 percent, non-condensing.

1.9 WARRANTY

- A. Provide a five year limited manufacturer's warranty on all room control devices and panels.

1.10 MAINTENANCE

- A. Spare Parts:
1. Provide the minimum of 5% or [5] of each of the following spares of each product that are used on this project to be used for maintenance as listed below:
 - a. Single-zone room controller
 - b. Two-zone room controller
 - c. Three-zone room controller
 - d. Single-zone dimming controller
 - e. Two-zone dimming controller
 - f. Three-zone dimming controller
 - g. Fixture controller
 - h. Network bridge
 - i. Isolated auxiliary relay
 - j. Ceiling occupancy sensor (each type used)
 - k. Wall mount occupancy sensor (each type used)
 - l. Wall switch (each type used)
 - m. Interior photocell

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer:
1. Basis of design product: WattStopper Digital Lighting Management (DLM) or subject to compliance and prior approval with specified requirements of this section, one of the following:
 - a. See Drawings for other approved manufacturers
 1. Substitutions: All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.

2.2 DIGITAL LIGHTING CONTROLS

- A. Furnish the Company's system which accommodates the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories which suit the lighting and electrical system parameters.

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2.3 DLM LOCAL NETWORK (Room Network)

- A. The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.
- B. Features of the DLM local network include:
 - 1. Plug n' Go™ automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
 - 2. Simple replacement of any device in the local DLM network with a standard off the shelf unit without requiring significant commissioning, configuration or setup.
 - 3. Push n' Learn™ configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
 - 4. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.
- C. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.
- D. If manufacturer's pre-terminated Cat5e cables are not used for the installation, the contractor is responsible for testing each cable following installation and supplying manufacturer with test results.
- E. WattStopper Product Number: LMRJ-Series

2.4 DIGITAL LOAD CONTROLLERS (ROOM AND FIXTURE CONTROLLERS)

- A. Digital controllers for lighting loads automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room load controllers shall be provided to match the room lighting load control requirements. The controllers will be simple to install, and will not have dip switches or potentiometers, or require special configuration for standard Plug n' Go applications. The control units will include the following features:
 - 1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 - 2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf.
 - 3. Multiple room controllers connected together in a local network must automatically arbitrate with each other, without requiring any configuration or setup, so that individual load numbers are sequentially assigned using each controller's device ID's from highest to lowest.
 - 4. Device Status LEDs to indicate:
 - a. Data transmission
 - b. Device has power
 - c. Status for each load

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- d. Configuration status
5. Quick installation features including:
 - a. Standard junction box mounting
 - b. Quick low voltage connections using standard RJ-45 patch cable
6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
 - a. Turn on to 100%
 - b. Turn off
 - c. Turn on to last level
7. Each load shall at a minimum be configurable to operate in the following sequences based on occupancy:
 - a. Auto-on/Auto-off (Follow on and off)
 - b. Manual-on/Auto-off (Follow off only)
8. The polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
9. BACnet object information shall be available for the following objects:
 - a. Load status
 - b. Electrical current (when available)
 - c. Total watts per controller
 - d. Schedule state – normal or after-hours
 - e. Demand response enable and disable
 - f. Room occupancy status
 - g. Total room lighting loads watts
 - h. Total room watts/sq ft
 - i. Force on/off all loads
10. UL 2043 plenum rated
11. Manual override and LED indication for each load
12. Dual voltage (120/277 VAC, 60 Hz), or 347 VAC, 60 Hz (selected models only). 120/277 volt models rated for 20A total load, derating to 16A required for some dimmed loads (forward phase dimming); 347 volt models rated for 15A total load.
13. Zero cross circuitry for each load
14. All digital parameter data programmed into an individual room controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
- B. On/Off Room Controllers shall include:
 1. One or two relay configuration
 2. Efficient 150 mA switching power supply
 3. Three RJ-45 DLM local network ports with integral strain relief and dust cover
 4. WattStopper product numbers: LMRC-101, LMRC-102
- C. On/Off/Dimming enhanced Room Controllers shall include:
 1. Real time current monitoring
 2. Multiple relay configurations
 - a. One, two or three relays (LMRC-21x series)
 - b. One or two relays (LMRC-22x series)
 3. Efficient 250 mA switching power supply
 4. Four RJ-45 DLM local network ports with integral strain relief and dust cover
 5. One dimming output per relay

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- a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting. (LMRC-21x series)
 - b. Line Voltage, Forward Phase Dimming - Where indicated, one forward phase control line voltage dimming output per relay for control of compatible two-wire or three-wire ballasts, LED drivers, MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads. (LMRC-22x series)
 - c. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver.
 - d. The LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
 - e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100% dimming range defined by the minimum and maximum calibration trim.
 - f. Calibration and trim levels must be set per output channel.
 - g. Devices that set calibration or trim levels per controller are not acceptable.
 - h. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.
6. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
 7. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
 8. The following dimming attributes may be changed or selected using a wireless configuration tool:
 - a. Establish preset level for each load from 0-100%
 - b. Set high and low trim for each load
 - c. Set lamp burn in time for each load up to 100 hours
 9. Override button for each load provides the following functions:
 - a. Press and release for on/off control
 - b. Press and hold for dimming control
 10. WattStopper product numbers: LMRC-211, LRMC-212, LRMC-213, LMRC-221, LMRC-222
- D. Fixture Controllers shall include:
1. A form factor and product ratings to allow various OEM fixture manufacturers to mount the device inside the ballast/driver cavity of standard-sized fluorescent or LED general lighting fixtures.
 2. One 3A 120/277V rated mechanically held relay.
 3. Programmable behavior on power up following the loss of normal power:

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- a. Turn on to 100%
 - b. Turn off
 - c. Turn on to last level
4. Requirement for 7 mA of 24VDC operating power from the DLM local network.
 - a. The Fixture Controller does not require a connection to a neutral conductor to operate, and unlike other types of Load Controllers it does not contribute power to the DLM local network to drive accessory devices.
 - b. Power to drive the LMFC Fixture Controller electronics can come from any Room Load Controller, LMPB-100 Power Booster and/or LMZC-301 Zone Controller (described later in the LMCP LIGHTING CONTROL PANELS specification section).
 5. 0-10V dimming capability via a single 0-10 volt analog output from the device for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Fixture Controller.
 6. Terminals to connect an RJ-45 adaptor with 24" leads, mountable in a ½" KO, for connection to the DLM local network.
 - a. The adaptor leads are insulated for use in a fixture cavity, and the lead length allows the OEM fixture manufacturer flexibility to position the Fixture Controller and the RJ45 jack in the best locations on each fixture.
 7. A complete set of dimming features described above in the section detailing On/Off/Dimming Enhanced Room Controllers (subsection C.5 onward).
 8. WattStopper product numbers: Fixture Controller: LMFC-011, DLM Cable Connector: LMFC-RJ-50-24, Power Booster: LMPB-100

2.5 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR

- A. Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor.
- B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
 1. Digital calibration and pushbutton configuration for the following variables:
 - a. Sensitivity – 0-100% in 10% increments
 - b. Time delay – 1-30 minutes in 1 minute increments
 - c. Test mode – Five second time delay
 - d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - e. Walk-through mode
 2. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
 3. Programmable control functionality including:
 - a. Each sensor may be programmed to control specific loads within a local network.
 - b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
 - c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.

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- d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
 - e. Ultrasonic and Passive Infrared
 - f. Ultrasonic or Passive Infrared
 - g. Ultrasonic only
 - h. Passive Infrared only
 - i. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
4. One or two RJ-45 port(s) for connection to DLM local network.
5. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
6. Device Status LEDs, which may be disabled for selected applications, including:
 - a. PIR detection
 - b. Ultrasonic detection
 - c. Configuration mode
 - d. Load binding
7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
8. Manual override of controlled loads.
9. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.
- C. BACnet object information shall be available for the following objects:
 1. Detection state
 2. Occupancy sensor time delay
 3. Occupancy sensor sensitivity, PIR and Ultrasonic
- D. Units shall not have any dip switches or potentiometers for field settings.
- E. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- F. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

2.6 DIGITAL WALL SWITCH OCCUPANCY SENSORS

- A. Wallbox mounted passive infrared PIR or dual technology (passive infrared and ultrasonic) digital occupancy sensor with 1 or 2 switch buttons.
- B. Digital Occupancy Sensors shall provide scrolling LCD display for digital calibration and electronic documentation. Features include the following:
 1. Digital calibration and pushbutton configuration for the following variables:
 - a. Sensitivity – 0-100% in 10% increments
 - b. Time delay – 1-30 minutes in 1 minute increments
 - c. Test mode – Five second time delay
 - d. Detection technology – PIR, Dual Technology activation and/or re-activation.
 - e. Walk-through mode

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- f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
 2. Programmable control functionality including:
 - a. Each sensor may be programmed to control specific loads within a local network.
 - b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
 - c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically during the configurable period of time (default 10 seconds) after turning off.
 - d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
 - i Ultrasonic and Passive Infrared
 - ii Ultrasonic or Passive Infrared
 - iii Ultrasonic only
 - iv Passive Infrared only
 3. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
 4. Two RJ-45 ports for connection to DLM local network.
 5. Two-way infrared (IR) transceiver to allow remote programming through handheld configuration tool and control by remote personal controls.
 6. Device Status LEDs including
 - a. PIR detection
 - b. Ultrasonic detection
 - c. Configuration mode
 - d. Load binding
 7. Assignment of any occupancy sensor to a specific load within the room without wiring or special tools.
 8. Assignment of local buttons to specific loads within the room without wiring or special tools
 9. Manual override of controlled loads
 10. All digital parameter data programmed into an individual wall switch sensor shall be retained in non-volatile FLASH memory within the wall switch sensor itself. Memory shall have an expected life of no less than 10 years.
- C. BACnet object information shall be available for the following objects:
 1. Detection state
 2. Occupancy sensor time delay
 3. Occupancy sensor sensitivity, PIR and Ultrasonic
 4. Button state
 5. Switch lock control
 6. Switch lock status
- D. Units shall not have any dip switches or potentiometers for field settings.
- E. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

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- F. Two-button wall switch occupancy sensors, when connected to a single relay dimming room or fixture controller, shall operate in the following sequence as a factory default:
 - 1. Left button
 - a. Press and release - Turn load on
 - b. Press and hold - Raise dimming load
 - 2. Right button
 - a. Press and release - Turn load off
 - b. Press and hold - Lower dimming load
- G. Low voltage momentary pushbuttons shall include the following features:
 - 1. Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED
 - b. Dim locator level indicates power to switch
 - c. Bright status level indicates that load or scene is active
 - 2. The following button attributes may be changed or selected using a wireless configuration tool:
 - a. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 - b. Individual button function may be configured to Toggle, On only or Off only.
 - c. Individual scenes may be locked to prevent unauthorized change.
 - d. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 - e. Ramp rate may be adjusted for each dimmer switch.
 - f. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.
 - g. WattStopper part numbers: LMPW, LMDW. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

2.7 DIGITAL WALL SWITCHES

- A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:
 - 1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
 - 2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
 - 3. Configuration LED on each switch that blinks to indicate data transmission.
 - 4. Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED
 - b. Dim locator level indicates power to switch
 - c. Bright status level indicates that load or scene is active
 - d. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
 - 5. Programmable control functionality including:

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- a. Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority
 - b. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.
6. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.
- B. BACnet object information shall be available for the following objects:
 1. Button state
 2. Switch lock control
 3. Switch lock status
- C. Two RJ-45 ports for connection to DLM local network.
- D. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.
- E. The following switch attributes may be changed or selected using a wireless configuration tool:
- F. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 1. Individual button function may be configured to Toggle, On only or Off only.
 2. Individual scenes may be locked to prevent unauthorized change.
 3. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 4. Ramp rate may be adjusted for each dimmer switch.
 5. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependant; each button may be bound to multiple loads.
 6. WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

2.8 DIGITAL DAYLIGHTING SENSORS

- A. Digital daylighting sensors shall work with load controllers and relay panels to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to the controller or panel. Daylighting sensors shall be interchangeable without the need for rewiring.
 1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
 2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.

3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone.
- B. Digital daylighting sensors shall include the following features:
 1. The sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
 2. Sensor light level range shall be from 1-6,553 footcandles (fc).
 3. The capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of load controller(s) and load binding to controller(s).
 4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
 5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
 6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
 7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
 8. Optional wall switch override shall allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise lighting levels for a selectable period of time or cycle of occupancy.
 9. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
 10. Configuration LED status light on device that blinks to indicate data transmission.
 11. Status LED indicates test mode, override mode and load binding.
 12. Recessed switch on device to turn controlled load(s) ON and OFF.
 13. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:
 - a. Light level
 - b. Day and night setpoints
 - c. Off time delay
 - d. On and off setpoints
 - e. Up to three zone setpoints
 - f. Operating mode – on/off, bi-level, tri-level or dimming
 14. One RJ-45 port for connection to DLM local network.
 15. A choice of accessories to accommodate multiple mounting methods and building materials. The photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors

accommodate mounting materials from 0-0.62" thickness (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62"-1.25" thickness (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well.

16. Any load or group of loads in the room can be assigned to a daylighting zone
 17. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
 18. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.
- C. Closed loop digital photosensors shall include the following additional features:
1. An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.
 2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
 3. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads.
 4. WattStopper Product Number: LMLS-400, LMLS-400-L.
- D. Open loop digital photosensors shall include the following additional features:
1. An internal photodiode that measures light in a 60-degree angle (cutting off the unwanted light from the interior of the room).
 2. Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.
 3. Each of the three discrete daylight zones can include any non overlapping group of loads in the room.
 4. WattStopper Product Number: LMLS-500, LMLS-500-L.
- E. Dual loop digital photosensors shall include the following additional features:
1. Close loop portion of dual loop device must have an internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from sources outside of this cone
 2. Open loop portion of dual loop device must have an internal photodiode that can measure light in a 60 degree angle, cutting off the unwanted light from the interior of the room.
 3. Automatically establishes application-specific set-points following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of load.

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4. Device must reference closed loop photosensor information as a base line reference. The device must be able to analyze the open loop photosensor information to determine if an adjustment in light levels is required.
5. Device must be able to automatically commission setpoints each night to provide adjustments to electrical lighting based on changes in overall lighting in the space due to changes in reflectance within the space or changes to daylight contribution based on seasonal changes.
6. Device must include extendable mounting arm to properly position sensor within a skylight well.
7. WattStopper product number LMLS-600

2.9 DIGITAL PARTITION CONTROLS

- A. Partition controls shall enable manual or automatic coordination of lighting controls in flexible spaces with up to four moveable walls by reconfiguring the connected digital switches and occupancy sensors.
- B. Four-button low voltage pushbutton switch for manual control.
 1. Two-way infrared (IR) transceiver for use with configuration remote control.
 2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
 3. Configuration LED on each switch that blinks to indicate data transmission.
 4. Each button represents one wall; Green button LED indicates status.
 5. Two RJ-45 ports for connection to DLM local network.
 6. WattStopper part number: LMPS-104. Available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening.
- C. Contact closure interface for automatic control via input from limit switches on movable walls (by others).
 1. Operates on Class 2 power supplied by DLM local network.
 2. Includes 24VDC output and four input terminals for maintained third party contact closure inputs.
 3. Input max. sink/source current: 1-5mA
 - a. Logic input signal voltage High: >18VDC
 - b. Logic input signal voltage Low: <2VDC
 4. Four status LEDs under hinged cover indicate if walls are open or closed; supports LMPS-104 as remote status indicator.
 5. Two RJ-45 ports for connection to DLM local network.
 6. WattStopper part number: LMIO-102

2.10 HANDHELD AND COMPUTER CONFIGURATION TOOLS

- A. A wireless configuration tool facilitates optional customization of DLM local networks using two-way infrared communications, while PC software connects to each local network via a USB interface.
- B. Features and functionality of the wireless configuration tool shall include but not be limited to:

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1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
 2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
 3. Must be able to read and modify parameters for load controllers and relay panels, occupancy sensors, wall switches, daylighting sensors, network bridges, and identify DLM devices by type and serial number.
 4. Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.
 5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
 6. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.
 7. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
 8. Verify status of building level network devices.
- C. WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100

2.11 DLM SEGMENT NETWORK (Room to Room Network)

- A. The segment network shall be a linear topology, BACnet-based MS/TP subnet to connect DLM local networks (rooms) and LMCP relay panels for centralized control.
 1. Each connected DLM local network shall include a single network bridge (LMBC-300), and the network bridge is the only room-based device that is connected to the segment network.
 2. Network bridges, relay panels and segment managers shall include terminal blocks, with provisions for separate "in" and "out" terminations, for segment network connections.
 3. The segment network shall utilize 1.5 twisted pair, shielded, cable supplied by the lighting control manufacturer. The maximum cable run for each segment is 4,000 feet. Conductor-to-conductor capacitance of the twisted pair shall be less than 30 pf/ft and have a characteristic impedance of 120 Ohms.
 4. Network signal integrity requires that each conductor and ground wire be correctly terminated at every connected device.
 5. Substitution of manufacturer-supplied cable must be pre-approved: Manufacturer will not certify network reliability, and reserves the right to void warranty, if non-approved cable is installed, and if terminations are not completed according to manufacturer's specific requirements.
 6. Segment networks shall be capable of connecting to BACnet-compliant BAS (provided by others) either directly, via MS/TP, or through NB-ROUTERS, via BACnet/IP or BACnet/Ethernet. Systems whose room-connected network infrastructure require gateway devices to provide BACnet data to a BAS are unacceptable.
- B. WattStopper Product Number: LM-MSTP, LM-MSTP-DB

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2.12 NETWORK BRIDGE

- A. The network bridge module connects a DLM local network to a BACnet-compliant segment network for communication between rooms, relay panels and a segment manager or BAS. Each local network shall include a network bridge component to provide a connection to the local network room devices. The network bridge shall use industry standard BACnet MS/TP network communication and an optically isolated EIA/TIA RS-485 transceiver.
1. The network bridge shall be provided as a separate module connected on the local network through an available RJ-45 port.
 2. Provide Plug n' Go operation to automatically discover room devices connected to the local network and make all device parameters visible to the segment manager via the segment network. No commissioning shall be required for set up of the network bridge on the local network.
 3. The network bridge shall automatically create standard BACnet objects for selected DLM devices to allow any BACnet-compliant BAS to include lighting control and power monitoring features as provided by the DLM devices on each local network. BACnet objects will be created for the addition or replacement of any given DLM device for the installed life of the system. Products requiring that an application-specific point database be loaded to create or map BACnet objects are not acceptable. Systems not capable of providing BACnet data for control devices via a dedicated BACnet Device ID and physical MS/TP termination per room are not acceptable. Standard BACnet objects shall be provided as follows:
 - a. Read/write the normal or after hours schedule state for the room
 - b. Read the detection state of each occupancy sensor
 - c. Read the aggregate occupancy state of the room
 - d. Read/write the On/Off state of loads
 - e. Read/write the dimmed light level of loads
 - f. Read the button states of switches
 - g. Read total current in amps, and total power in watts through the load controller
 - h. Read/write occupancy sensor time delay, PIR sensitivity and ultrasonic sensitivity settings
 - i. Activate a preset scene for the room
 - j. Read/write daylight sensor fade time and day and night setpoints
 - k. Read the current light level, in footcandles, from interior and exterior photosensors and photocells
 - l. Set daylight sensor operating mode
 - m. Read/write wall switch lock status
 - n. Read watts per square foot for the entire controlled room
 - o. Write maximum light level per load for demand response mode
 - p. Read/write activation of demand response mode for the room
 - q. Activate/restore demand response mode for the room
- B. WattStopper product numbers: LMBC-300

2.13 LMCP LIGHTING CONTROL PANELS AND LMZC ZONE CONTROLLER

A. HARDWARE:

Provide LMCP lighting control panels in the locations and capacities as indicated on

the plans and schedules. Each panel shall be of modular construction and consist of the following components:

1. Enclosure/Tub shall be NEMA 1, sized to accept an interior with 1 - 8 relays, 1 - 24 relays and 6 four-pole contactors, or 1 - 48 relays and 6 four-pole contactors.
2. Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. LMCP panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.
3. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. The interior construction shall provide total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel. The interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. The panel interiors shall include the following features:
 - a. Removable, plug-in terminal blocks with connections for all low voltage terminations.
 - b. Individual terminal block, override pushbutton, and LED status light for each relay.
 - c. Direct wired switch inputs associated with each relay shall support 2-wire momentary switches only.
 - d. Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches; digital IO modules capable of receiving 0-5V or 0-10V analog photocell inputs; digital IO modules capable of receiving momentary or maintained contact closure inputs or analog sensor inputs; digital daylighting sensors; and digital occupancy sensors. Inputs are divided into two separate digital networks, each capable of supplying 250mA to connected devices.
 - e. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet.
 - f. Automatically sequenced operation of relays to reduce impact on the electrical distribution system when large loads are controlled simultaneously.
 - g. Group and pattern control of relays shall be provided through a simple keypad interface from a handheld IR programmer. Any set of relays can be associated with a group for direct on/off control or pattern (scene) control via a simple programming sequence using the relay override pushbuttons and LED displays for groups 1-8 or a handheld IR programmer for groups 1-99.
 - h. Relay group status for shall be provided through LED indicators for groups 1-8 and via BACnet for groups 1-99. A solid LED indicates that the last group action called for an ON state and relays in the group are on or in a mixed state.
4. Single-pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:
 - a. Electrical:
 - i 30 amp ballast at 277V
 - ii 20 amp ballast at 347V
 - iii 20amp tungsten at 120V

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- iv 30 amp resistive at 347V
- v 1.5 HP motor at 120V
- vi 14,000 amp short circuit current rating (SCCR) at 347V
- vii Relays shall be specifically UL 20 listed for control of plug-loads
- b. Mechanical:
 - i Replaceable, ½" KO mounting with removable Class 2 wire harness.
 - ii Actuator on relay housing provides manual override and visual status indication, accessible from Class 2 section of panel.
 - iii Dual line and load terminals each support two #14 - #12 solid or stranded conductors.
 - iv Tested to 300,000 mechanical on/off cycles.
- 5. Isolated low voltage contacts provide for true relay status feedback and pilot light indication.
- 6. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.
- 7. Where indicated, lighting control panels designated for control of emergency lighting shall be provided with factory installed provision for automatic by pass of relays controlling emergency circuits upon loss of normal power. Panels shall be properly listed and labeled for use on emergency lighting circuits and shall meet the requirements of UL924 and NFPA 70 - Article 700.
- 8. Integral system clock shall provide scheduling capabilities for panel-only projects without DLM segment networks or BAS control.
 - a. Each panel shall include digital clock capability able to issue system wide automation commands to up to (11) eleven other panels for a total of (12) twelve networked lighting control panels. The clock shall provide capability for up to 254 independent schedule events per panel for each of the ninety-nine system wide channel groups.
 - b. The clock capability of each panel shall support the time-based energy saving requirements of applicable local energy codes.
 - c. The clock module shall provide astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and will include a battery back up for the clock function and program retention in non-volatile FLASH memory. Clocks that require multiple events to meet local code lighting shut off requirements shall not be allowed.
 - d. The clock capability of each panel shall operate on a basis of ON/OFF or Normal Hours/After Hours messages to automation groups that implement pre-configured control scenarios. Scenarios shall include:
 - i Scheduled ON / OFF
 - ii Manual ON / Scheduled OFF
 - iii Astro ON / OFF (or Photo ON / OFF)
 - iv Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF)

- e. The user interface shall be a portable IR handheld remote control capable of programming any panel in the system (LMCT-100)
 - f. The clock capability of each panel shall employ non-volatile memory and shall retain user programming and time for a minimum of 10 years.
 - g. Schedules programmed into the clock of any one panel shall be capable of executing panel local schedule or Dark/Light (photocell or Astro) events for that panel in the event that global network communication is lost. Lighting control panels that are not capable of executing events independently of the global network shall not be acceptable.
9. The lighting control panel can operate as a stand-alone system, or can support schedule, group, and photocell control functions, as configured in a Segment Manager controller, via a segment network connection.
10. The lighting control panel shall support digital communications to facilitate the extension of control to include interoperation with building automation systems and other intelligent field devices. Digital communications shall be RS485 MS/TP-based using the BACnet® protocol.
- a. The panel shall have provision for an individual BACnet device ID and shall support the full 222 range (0 – 4,193,304). The device ID description property shall be writable via the network to allow unique identification of the lighting control panel on the network.
 - b. The panel shall support MS/TP MAC addresses in the range of 0 – 127 and baud rates of 9600k, 38400k, 76800k, and 115.2k bits per second.
 - c. Lighting control relays shall be controllable as binary output objects in the instance range of 1 – 64. The state of each relay shall be readable and writable by the BAS via the object present value property.
 - d. Lighting control relays shall report their true on/off state as binary input objects in the instance range of 1 – 64.
 - e. The 99 group Normal Hours/After Hours control objects associated with the panel shall be represented by binary value objects in the instance range of 201 – 299. The occupancy state of each channel group shall be readable and writable by the BAS via the object present value property. Commanding 1 to a channel group will put all relays associated with the channel into the normal hours mode. Commanding 0 or NULL shall put the relays into the after hours mode.
 - f. Setup and commissioning of the panel shall not require manufacturer-specific software or a computer. All configuration of the lighting control panel shall be performed using standard BACnet objects or via the handheld IR programming remote. Provide BACnet objects for panel setup and control as follows:
 - i. Binary output objects in the instance range of 1 – 64 (one per relay) for on/off control of relays.
 - ii. Binary value objects in the instance range of 1 – 99 (one per channel) for normal hours/after hours schedule control.
 - iii. Binary input objects in the instance range of 1 – 64 (one per relay) for reading true on/off state of the relays.

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- iv Analog value objects in the instance range of 101 – 199 (one per channel group) shall assign a blink warn time value to each channel. A value of 5 shall activate the blink warn feature for the channel and set a 5-minute grace-time period. A value of 250 shall activate the sweep feature for the channel and enable the use of sweep type automatic wall switches.
 - g. The description property for all objects shall be writable via the network and shall be saved in non-volatile memory within the panel.
 - h. The BO and BV 1 – 99 objects shall support BACnet priority array with a relinquish default of off and after hours respectively. Prioritized writes to the channel BV objects shall propagate prioritized control to each member relay in a way analogous to the BACnet Channel object described in addendum aa. (<http://www.bacnet.org/Addenda/Add-135-2010aa.pdf>)
 - i. Panel-aggregate control of relay Force Off at priority 2 shall be available via a single BV5 object. Force On at priority 1 shall be available via a single BV4 object.
 - j. Lockout of all digital switch buttons connected to a given panel shall be command-able via a single BV2 object. The lock status of any connected switch station shall be represented as BV101-196.
11. In addition to the LMCP Relay Panels, an LMZC Zone Controller panel shall be available for zero-relay applications. The panel is designed for applications where LMFC-011 Fixture Controllers or other distributed load controllers are used to switch and/or dim the controlled loads. Key similarities to and differences from the LMCP panel design shall include:
- a. The LMZC shall use the same intelligence board as the LMCP relay panel.
 - b. The LMZC shall not include relay driver boards or relays.
 - c. The LMZC shall have a removable interior section to facilitate installation, and a Tub/Cover. Cover is for surface mounting applications only.
 - d. The LMZC tub shall have two interior KOs to allow installation of LMPB-100 Power Boosters. Each installed Power Booster can provide an additional 150 mA for either of the two available DLM local networks provided by the LMZC.
 - e. All programming and networking (whether DLM Local Network and/or Segment Network) capabilities in the LMZC Zone Controller shall be similar to capabilities for LMCP relay panels, except for functions designed for panel-mounted HDR relays.
12. To aid in project start up, if LMFC Fixture Controllers are connected to an LMZC Zone Controller, Plug n' Go automatic configuration will establish a unique sequence of operation so that all LMFC-controlled fixtures will turn on to 50% output when any digital occupancy sensor detects motion..
13. WattStopper Product Number: Relay Panels: LMCP8, LMCP24 or LMCP48, Zone Controller: LMZC-301.

B. USER INTERFACE

Each lighting control panel system shall be supplied with at least (1) handheld configuration tool (LMCT-100). As a remote programming interface the configuration tool shall allow setup, configuration, and diagnostics of the panel without the need

for software or connection of a computer. The user interface shall have the following panel-specific functions as a minimum:

1. Set network parameters including panel device ID, MS/TP MAC address, baud rate and max master range.
2. Relay Group creation of up to 99 groups. Group creation shall result in programming of all seven key relay parameters for member relays. The seven parameters are as follows: After-hours Override Time Delay, Normal Hours Override Time Delay, Action on Transition to Normal Hours, Action on Transition to After Hours, Sensor Action During Normal Hours, Sensor Action During After Hours, Blink-Warn Time for After Hours.
3. Program up to 254 separate scheduled events. Events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays. Holidays are also defined through the User Interface.
4. Program up to 32 separate Dark/Light events. Events shall have a selectable source as either calculated Astro with delay, or a digital IO module with an integral 0-5V or 0-10V analog photocell. Dark/Light events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays.
5. Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.
6. Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.
7. WattStopper Product Number: LMCT-100

2.14 SEGMENT MANAGER

- A. For networked applications, the Digital Lighting Management system shall include at least one segment manager to manage network communication. It shall be capable of serving up a graphical user interface via a standard web browser utilizing either unencrypted TCP/IP traffic via a configurable port (default is 80) or 256 bit AES encrypted SSL TCP/IP traffic via a configurable port (default is 443).
- B. Each segment manager shall have integral support for at least three segment networks. Segment networks may alternately be connected to the segment manger via external BACnet-to-IP interface routers and switches, using standard Ethernet structured wiring. Each router shall accommodate one segment network. Provide the quantity of routers and switches as shown on the plans.
- C. Operational features of the Segment Manager shall include the following:
 1. Connection to PC or LAN via standard Ethernet TCP/IP via standard Ethernet TCP/IP with the option to use SSL encrypted connections for all traffic.
 2. Easy to learn and use graphical user interface, compatible with Internet Explorer 8, or equal browser. The Segment Manager shall not require installation of any lighting control software on an end-user PC.
 3. Log in security capable of restricting some users to view-only or other limited operations.
 4. Segment Manager shall provide two main sets of interface screens – those used to initially configure the unit (referred to as the config screens), and a

those used to allow users to dynamic monitor the performance of their system, and provide a centralized scheduling interface.

Capabilities using the Config Screens shall include:

- a. Automatic discovery of DLM devices and relay panels on the segment network(s). Commissioning beyond activation of the discovery function shall not be required to provide communication, monitoring or control of all local networks and lighting control panels.
 - b. Allow information for all discovered DLM devices to be imported into the Segment Manager via a single XML based site file from the WattStopper LMCS Software, significantly reducing the time needed to make a system usable by the end user. Importable information can include text descriptions of every DLM component and individual loads, and automatic creation of room location information and overall structure of DLM network. Info entered into LMCS should not have to be re-entered manually via keystrokes into the Segment Manager
 - c. After discovery, all rooms and panels shall be presented in a standard navigation tree format. Selecting a device from the tree will allow the device settings and operational parameters to be viewed and changed by the user.
 - d. Ability to view and modify DLM device operational parameters. It shall be possible to set device parameters independently for normal hours and after hours operation including sensor time delays and sensitivities, and load response to sensor including Manual-On or Auto-On.
 - e. Provide capabilities for integration with a BAS via BACnet protocol. At a minimum, the following points shall be available to the BAS via BACnet IP connection to the segment manager: room occupancy state; room schedule mode; room switch lock control; individual occupancy sensor state; room lighting power; room plug-load power; load ON/OFF state; load dimming level; panel channel schedule state; panel relay state; and Segment Manager Group schedule state control. Any of above items shall be capable of being moved into an "Export Table" that will provide any integrator with only the data they need, and by using the Export Table effectively create a firewall between the integrator's request for info and the overall system performance.
5. Capabilities using the Segment Manager's Dashboard Screens shall include:
- a. A dynamic "tile" based interface that allows easy viewing of each individual room's lighting and plug load power consumption, and lighting and plug load power density (power consumption information requires Enhanced DLM Room and Plug Load Controllers with integral current transducers such as LMRC-21x). Tiles will be automatically organized according to location so a single tile for the building summarizes all information for tiles beneath it on every floor, in every area, in every room. Tiles shall be color coded based on three energy target parameters, allowing an owner to quickly identify rooms that are not performing efficiently. Tiles for

rooms with occupancy sensors shall include an icon to indicate whether that room is occupied. Tiles shall be clickable, and when clicked the underlying hierarchical level of tiles shall become visible. The tile interface shall be accessible via mouse, or touch screen devices. Tiles shall be created automatically by the segment manager, based on the information found during the device discovery and/or information included in a file imported in from LMCS (such as tagged descriptions for each room) without any custom programming.

- b. Ability to set up schedules for DLM local networks (rooms) and panels. Schedules shall be capable of controlling individual rooms with either on/off or normal hours/after hours set controlled zones or areas to either a normal hours or after hours mode of operation. Support for annual schedules, holiday schedules and unique date-bound schedules, as well as astro On or astro Off events with offsets. Schedules shall be viable graphically as time bars in a screen set up to automatically show scheduled events by day, week or month.
 - c. Ability to provide a simple time vs. power graph based on information stored in each Segment Manager's memory (typically two to three days' data).
6. If shown in the contract drawings, Segment Managers shall be integrated into a larger control network by the addition of a Network Supervisor package. The Supervisor is a server level computer running a version of the Segment Manager interface software with dedicated communication and networking capability, able to pull information automatically from each individual Segment Manager in the network. By using a Supervisor, information for individual Segment Managers can be accessed and stored on the Supervisor's hard drive, eliminating the risk of data being overwritten after a few days because of Segment Manager memory limits.
7. The Segment Manager shall allow access and control of the overall system database via Native Niagara AX FOX connectivity. Systems that must utilize a Tridium Niagara controller in addition to the programming, scheduling and configuration server are not acceptable.
- D. Segment Manager shall support multiple DLM rooms as follows:
- 1. Support up to 120 network bridges and 900 digital in-room devices (LMSM-3E).
 - 2. Support up to 300 network bridges and 2,200 digital in room devices, connected via network routers and switches (LMSM-6E).
- E. WattStopper Product Numbers: LMSM-3E, LMSM-6E, LM-SUPERVISOR, NB-ROUTER, NB-SWITCH, NB-SWITCH-8, NB-SWITCH-16.
- 2.15 PROGRAMMING, CONFIGURATION AND DOCUMENTATION SOFTWARE
- A. PC-native application for optional programming of detailed technician-level parameter information for all DLM products, including all parameters not accessible via BACnet and the handled IR configuration tool. Software must be capable of accessing room-level parameter information locally within the room when

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- connected via the optional LMCI-100 USB programming adapter, or globally for many segment networks simultaneously utilizing standard BACnet/IP communication.
- B. Additional parameters exposed through this method include but are not limited to:
 - 1. Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
 - 2. Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.
 - 3. Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
 - 4. Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.
 - 5. Separate normal hours and after hours per-load button mode with modes including: Do nothing, on only, off only, on and off.
 - 6. Load control polarity reversal so that on events turn loads off and vice versa.
 - 7. Per-load DR (demand response) shed level in units of percent.
 - 8. Load output pulse mode in increments of 1second.
 - 9. Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered On of switched loads in response to a dimmer.
 - C. Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:
 - 1. Device list report: All devices in a project listed by type.
 - 2. Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.
 - 3. BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.
 - 4. Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.
 - 5. Device parameter report: Per-room lists of all configured parameters accessible via hand held IR programmer for use with O&M documentation.
 - 6. Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100%, 2 = all loads 75%, 3 = all loads 50%, 4 = all loads 25%, 5-16 = same as scene 1).
 - 7. Occupancy sensor report: Basic settings including time delay and sensitivity(ies) for all occupancy sensors.
 - D. Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:
 - 1. Set, copy/paste an entire project site of sensor time delays.
 - 2. Set, copy/paste an entire project site of sensor sensitivity settings.
 - 3. Search based on room name and text labels.
 - 4. Filter by product type (i.e. LMRC-212) to allow parameter set by product.
 - 5. Filter by parameter value to search for product with specific configurations.
 - E. Network-wide firmware upgrading remotely via the BACnet/IP network.

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1. Mass firmware update of entire rooms.
2. Mass firmware update of specifically selected rooms or areas.
3. Mass firmware upgrade of specific products.

F. WattStopper Product Number: LMCS-100, LMCI-100

2.16 EMERGENCY LIGHTING CONTROL DEVICES

A. Emergency Lighting Control Unit – A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:

1. 120/277 volts, 50/60 Hz, 20 amp ballast rating
2. Push to test button
3. Auxiliary contact for remote test or fire alarm system interface

B. WattStopper Product Numbers: ELCU-100, ELCU-200.

PART 3 – EXECUTION

3.1 PRE-INSTALLATION MEETING

A. A factory authorized manufacturer's representative shall provide the electrical contractor a functional overview of the lighting control system prior to installation. The contractor shall schedule the pre-installation site visit after receipt of approved submittals to review the following:

1. Confirm the location and mounting of all digital devices, with special attention to placement of occupancy and daylighting sensors.
2. Review the specifications for low voltage control wiring and termination.
3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
4. Discuss requirements for integration with other trades.

3.2 CONTRACTOR INSTALLATION AND SERVICES

- A. Contractor to install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs.
- B. Contractor to install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable following installation, and shall supply the lighting controls manufacturer with test results. Contractor to install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification. Low voltage wiring topology must comply with manufacturer's specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.

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- C. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Before start up, contractor shall test all devices to ensure proper communication.
 - D. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
 - 1. Adjust time delay so that controlled area remains lighted while occupied.
 - E. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
 - 1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
 - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - 3. Load Parameters (e.g. blink warning, etc.)
 - F. Post start-up tuning – After 30 days from occupancy contractor shall adjust sensor time delays and sensitivities to meet the Owner's requirements. Provide a detailed report to the Architect / Owner of post start-up activity.
- 3.3 FACTORY SERVICES
- A. Upon completion of the installation, the manufacturer's factory authorized representative shall start up and verify a complete fully functional system.
 - B. The electrical contractor shall provide both the manufacturer and the electrical engineer with three weeks written notice of the system start up and adjustment date.
 - C. Upon completion of the system start up, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system
 - D. Include a certified lighting control acceptance verified in writing by the factory authorized representative.
- 3.4 COMMISSIONING SUPPORT SERVICES
- A. On this project, a commissioning agent will be hired to verify the installation and programming of all building systems, which includes the lighting control system. Manufacturer should include an extra day of technician's time to review the functionality and settings of the lighting control hardware with the commissioning agent, including reviewing submittal drawings and ensuring that instructions on how to configure each device are readily available. Manufacturer is NOT responsible for helping the commissioning agent inspect the individual devices. It will be the commissioning agent's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the agent with this task.
 - B. The commissioning agent shall work with the electrical contractor during installation of the lighting control hardware to become familiar with the specific products. The agent may also accompany the manufacturer's technicians during their start-up work to better understand the process of testing, calibration and configuration of the products. However, the contractor and manufacturer shall ensure that interfacing

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with the agent does not prevent them from completing the requirements outlined in the contract documents.

3.5 FINE TUNING AFTER SUBSTANTIAL COMPLETION

- A. Provide a factory authorized representative for fine tuning and adjustments to the system within 6 months after substantial completion as coordinated and requested by the Owner. Modify and adjust controls, settings, and programming as directed by Owner.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

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. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
- C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

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1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field Quality-Control Reports:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Panelboard Schedules: For installation in panelboards
- F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- 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. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations:

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1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding **minus 22 deg F (minus 30 deg C)** to **plus 104 deg F (plus 40 deg C)**.
 - b. Altitude: Not exceeding **6600 feet (2000 m)**.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 1. Ambient temperatures within limits specified.
 2. Altitude not exceeding **6600 feet (2000 m)**.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify Engineer and Owner no fewer than two days in advance of proposed interruption of electric service.
 2. Do not proceed with interruption of electric service without Engineer's and Owner's written permission.
 3. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces.
- B. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- C. Coordinate with work of other trades so that piping, ductwork or any equipment foreign to the electrical installation is not located directly above panelboards.
- D. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 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. Keys: Two spares for each type of panelboard cabinet lock.
 2. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

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PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets as indicated.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Kitchen Areas: NEMA 250, Type 4X.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within door cover.
 - 3. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 - 4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
 - 4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Lugs: rated for copper only.
 - 3. Main and Neutral Lugs: Mechanical type.
 - 4. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 5. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 6. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 - 7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

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- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
- I. 208 Volt Panels- All 208 volt panels and distribution boards shall include both a bonded and insulated ground bus. The insulated ground bus is intended to provide an isolated ground system for sensitive equipment.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric. (CED)
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- F. Branch Overcurrent Protective Devices: Fused switches.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric. (CED)
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

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- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Door within door style. Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- E. Covers: Hinged front cover (door-in-door) type.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 - 5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 - 6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - f. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- B. For all circuit breaker overcurrent devices with frames rated 1200A or more, provide adjustable instantaneous time delay and interconnect into the arc energy reduction system.

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- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 - 1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."
 - 2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
 - 3. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

2.6 ARC ENERGY REDUCTION SYSTEM

- A. For each overcurrent device with a frame size of 1200A or higher, provide an arc energy reduction system complying with 2023 NEC 240.87.
- B. System shall consist of an energy-reducing switch with local status indication. Status shall indicate whether the switch is on or off via illuminated blue LED indication lamp. Status indication shall be clearly and permanently marked.
- C. Provide permanent label with instruction for operating the arc energy reduction system and warning that any coordination that has been designed into the system may not exist while the arc energy reduction system in "ON."
- D. When the arc energy reduction switch is turned "ON" (placed in the "ON" position), the system shall bypass the overcurrent protection device delay settings so that the time delay is "OFF" (0 seconds) and illuminate the switch "ON" indication lamp. When the arc energy reduction switch is turned "OFF" (placed in the "OFF" position), the system shall revert back to the standard overcurrent protection device settings and appropriate delay.
- E. Provide all required components for a complete and fully functional arc energy reduction system.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Circuit Breaker Types:
 - 1. *Circuit Breakers 400A and larger: Solid-state, adjustable with LSI adjustments. For 480V circuit breakers 1000A and larger provide LSIIG adjustments.*
 - 2. *Circuit Breakers less than 400A: Molded case with instantaneous adjustments.*

3.2 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

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- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Equipment Mounting: Install floor-mounted panelboards on concrete bases, **4-inch (100-mm)** nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around full perimeter of base.
 - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
 - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- E. Mount top of trim 80 inches above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Install filler plates in unused spaces.
- I. Stub five **1-inch (27-GRC)** empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub five **1-inch (27-GRC)** empty conduits into raised floor space or below slab not on grade. Include pull strings in empty conduits.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

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- K. Comply with NECA 1.
- L. Fuse Selection and Installation: Verify connected load(s) and selection of fuse sizes for each disconnect switch prior to selection and installation.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and location in the building; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 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. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

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3.6 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Snap switches and wall-box dimmers.
 - 4. Pendant cord-connector devices.
 - 5. Cord and plug sets.
 - 6. Floor service outlets, poke-through assemblies, and multioutlet assemblies.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.4 SUBMITTALS

- A. Product Data: For each type of floor service outlet, poke-through assembly, and multi-outlet assembly and all colors for all devices.
 - 1. Finish and Color Submittal: Provide a complete finish and color submittal package with all finish and color options for each device available for the project. Architect shall provide selections based on this separate submittal.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

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- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Service/Power Poles: One for every 10, but no fewer than one.
 - 2. Poke-Through, Fire-Rated Closure Plugs: One for every ten floor service outlets installed, but no fewer than two.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles and in the Wiring Device Schedule:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide products from the manufacturers listed in the Wiring Device Schedule.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped. UL listed for weather-resistant with "WR" listing marked visibly on face.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide products from the manufacturers listed in the Wiring Device Schedule.

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2.4 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; L520R.
 - b. Hubbell; HBL2310.
 - c. Leviton; 2310.
 - d. Pass & Seymour; L520-R.
- B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; IG2310.
 - b. Leviton; 2310-IG.
 - 2. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.5 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
 - 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 - 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide products from the manufacturers listed in the Wiring Device Schedule.
- C. Pilot Light Switches, 20 A:

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1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
 2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- D. Key-Operated Switches, 120/277 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221L.
 - b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.
 2. Description: Single pole, with factory-supplied key in lieu of switch handle.
- E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995.
 - b. Hubbell; HBL1557.
 - c. Leviton; 1257.
 - d. Pass & Seymour; 1251.
- F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995L.
 - b. Hubbell; HBL1557L.
 - c. Leviton; 1257L.
 - d. Pass & Seymour; 1251L.

2.8 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Provide full range of finished metal wall plates as selected by the Architect, including satin-finished stainless steel.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
 5. All kitchen locations shall be brushed stainless steel.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover. Weatherproof while in use type.

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2.9 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Finish: brushed aluminum metal cover finish. Provide carpet insert where used in carpet installations.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable.

2.10 POKE-THROUGH ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
 - 3. Square D/ Schneider Electric.
 - 4. Thomas & Betts Corporation.
 - 5. Wiremold Company (The).
- B. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
 - 1. Service Outlet Assembly: Flush type with four simplex receptacles and space for four RJ-45 jacks.
 - 2. Size: Selected to fit nominal 6-inch cored holes in floor and matched to floor thickness.
 - 3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
 - 4. Closure Plug: Arranged to close unused 6-inch (75-mm) cored openings and reestablish fire rating of floor.
 - 5. Finish: Brushed aluminum metal cover finish.

2.11 MULTIOUTLET ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Wiremold Company (The).
- B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- C. Raceway Material: Metal, with brushed aluminum metal finish.
- D. Wire: No. 10 AWG.

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2.12 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: Red.
 - 3. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
 - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

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3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.
 2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the bottom.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
1. Install dimmers within terms of their listing.
 2. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.
 2. Emergency Outlets: Outlets installed on emergency power circuits shall be red. Other permanent identification of emergency outlets is acceptable only upon written approval from someone having authority in that jurisdiction.

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3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
 - 2. Test Instruments: Use instruments that comply with UL 1436.
 - 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

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SECTION 262726.1 - WIRING DEVICE SCHEDULE

Wiring Device Schedule		
<p>Note to Bidders: Comply with Section 262726 of the specifications. The catalog numbers listed below have been carefully prepared with the assistance of the manufacturer's representatives with the objective of assisting the bidders in determining the quality and ratings of the wiring device specified; however, the catalog numbers may not be complete or accurate. In addition, the color of the wiring device is not intended to be determined by the catalog numbers listed below, but shall be selected by the Architect as indicated in the specification. Each manufacturer prior to bidding shall compare catalog numbers shown with the description and shall notify the Architect/Engineer of any discrepancies.</p>		
NEMA	DESCRIPTION	CATALOG NUMBERS
NEMA 5-20R	20A, 125V 2 pole 3 wire duplex grounding receptacles. Nylon or Lexan Faces. Back and side wired. Comply with FS W-C-596 and UL 498.	Bryant 5352 Hubbell CR5352 Leviton 5352 P&S 5352
NEMA 5-20R GFCI	20A, 125V 2 pole 3 wire duplex feed thru GFCI receptacles UL-listed with indicator light. Nylon or Lexan decorator faces. Back and side wired. Internal components shall comply with FS W-C-596 where applicable. Comply with UL 498 and UL 493.	Bryant GFR53FT Hubbell GF5352 Leviton 6898 P&S 2091 S
NEMA 5-20R AFCI/GFCI	20A, 125V 2 pole 3 wire duplex feed thru AFCI/GFCI receptacles UL-listed with indicator light. Nylon or Lexan decorator faces. Back and side wired. Internal components shall comply with FS W-C-596 where applicable. Commercial Grade. Comply with UL 498 and UL 943.	Bryant AFGFR Hubbell AFGF Leviton P&S
NEMA 5-20R Isolated Ground	20A, 125V 2 pole 3 wire isolated ground duplex grounding receptacles. Nylon or Lexan faces. Back and side wired. Comply with FS W-C-596 and UL 498.	Bryant 5362IG Hubbell CR5352IG Leviton 5362 - IG P&S IG6300
NEMA 5-20R Waterproof (Weatherproof in use) GFCI	20A, 125V 2 pole 3 wire duplex feed thru GFCI receptacles with UL-listed and marked "WR" weather resistant; indicator light; Comply with FS W-C-596 and UL 498. Fully gasketed, metal weatherproof while in use enclosure. Plastic covers are not acceptable.	Leviton M5979-0GY cover With the following devices: Hubbell BR20WR Bryant CBR520WR
NEMA 5-20R Weatherproof GFCI	20A, 125V 2 pole 3 wire duplex feed thru GFCI receptacles with UL-listed and marked "WR" weather resistant; Nylon or Lexan Faces. Back and side wired. Comply with FS W-C-596 and UL 498. Cast aluminum and UL listed for wet locations.	Appleton U-Line/Contender ENRC 21201 With the following devices: Hubbell BR20WR Bryant CBR520WR

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NEMA 5-20R With USB	20A, 125V 2 pole 3 wire grounding, dead-front duplex receptacle with 2 USB ports at 3 amp, 5 VDC, Type C, 2.0.	Hubbell USB20C5 Bryant Leviton
NEMA 5-20R COPS (GFCI AS REQUIRED)	20A, 125V 2 pole 3 wire duplex grounding receptacles. Nylon or Lexan Faces. Back and side wired. Comply with NEC 708, FS W-C-596, UL 498, UL943.	Hubbell HBL8300ILR Bryant Leviton
Blank Face GFCI Device	20A, 125V blank GFCI devices, UL-listed with LED indication. Back and side wired. Nylon or Lexan decorator faces.	Leviton X7590 Cooper VGFD20 Hubbell GFBF20LA P&S 2084
20A Single Pole	20A single pole 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 1 HP 120V.	Hubbell CS1221 Leviton 1221 P & S 521 Bryant 4901
20A Three-way	20A three-way 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 1 HP 120V.	Hubbell CS1223 Leviton 1223 P & S 523 Bryant 4903
20A Four-way	20A four-way 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 1 HP 120V.	Hubbell CS1224 Leviton 1224 P & S 524 Bryant 4904
20A Double Pole	20A double pole 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 2 HP 240V. Double pole.	Hubbell CS1222 Leviton 1222 P & S 522 Bryant 4902

END OF SECTION 262726.1

SECTION 262813 - FUSES

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. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, panelboards, switchboards, enclosed controllers and motor-control centers.
 - 2. Spare-fuse cabinets.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.
- B. Operation and Maintenance Data: For fuses 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. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.
 - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 4. Coordination charts and tables and related data.

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1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

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2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

2.4 MECHANICAL EQUIPMENT

- A. Provide current limiting fuses on all large mechanical equipment rated 60 Amps and above to reduce fault current values at equipment to below 5,000 AIC.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Feeders: Class J, time delay.
 - 2. Motor Branch Circuits: Class RK5, time delay.
 - 3. Other Branch Circuits: Class J, time delay.
 - 4. Control Circuits: Class CC, time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Fuse Selection and Installation: Verify connected load(s) and selection of fuse sizes for each disconnect switch prior to selection and installation.

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- C. Install spare-fuse cabinet(s). Locate in the vicinity of the building main distribution panel.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

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SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Shunt trip switches.
 - 4. Molded-case circuit breakers (MCCBs).
 - 5. Molded-case switches.
 - 6. Enclosures.
 - 7. Elevator Power Module Shunt-Trip Fused Disconnects

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

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6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring.
 - C. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - D. Field quality-control reports.
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
 - E. Manufacturer's field service report.
 - F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- 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. Comply with NFPA 70.

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1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than **minus 22 deg F (minus 30 deg C)** and not exceeding **104 deg F (40 deg C)**.
 - 2. Altitude: Not exceeding **6600 feet (2010 m)**.
- B. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
 - 1. All lugs shall be rated copper only.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 5. Hookstick Handle: Allows use of a hookstick to operate the handle.

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6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
 1. All lugs shall be rated copper only.
- C. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 4. Hookstick Handle: Allows use of a hookstick to operate the handle.
 5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 1. Instantaneous trip.
 2. Long- and short-time pickup levels.

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3. Long- and short-time time adjustments.
 4. Ground-fault pickup level, time delay, and I^2t response.
- F. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- G. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- H. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Features and Accessories:
1. Standard frame sizes and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 3. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.

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2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2.6 ELEVATOR SHUNT-TRIP FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc. - Power Module PS
- B. Provide shunt-trip fused disconnect switch with all necessary relay(s), control transformer and other options, as shown on drawings and listed below:
 - 1. Ampere rating of the switch shall be based upon the elevator manufacturer requirements.
 - 2. Short-circuit current rating of 200,000A.
 - 3. Interlocks to prevent the opening of the cover when the switch is in the ON position. Interlock shall be defeatable for testing purposes.
 - 4. Handle lockable in OFF position.
 - 5. 100VA/120V control power transformer with primary and secondary fuses.
 - 6. Isolation relay (3PDT, 10amp, 120V). A normally open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt trip solenoid (140VA inrush at 120V). (Note: if 24V DC coil is selected, a separate 24V DC source and contact must be provided by the Fire Alarm Safety System.)
 - 7. Provide additional options as indicated below:
 - a. Key to Test Switch
 - b. "On" Pilot Light (Green, Red or White)
 - c. Isolated Full Capacity Neutral Lug
 - d. 1P NC Mechanical Interlock (required for hydraulic elevators with automatic recall).
 - e. Fire Alarm Voltage Monitoring Relay (Comply with NFPA 72)
 - f. NEMA 1 Enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices. Verify connected load(s) and selection of fuse sizes for each disconnect switch prior to selection and installation.
- E. Location: Equipment disconnecting means shall be immediately next to the equipment which it services.
- F. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 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. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

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- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

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 the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual.
 - 2. Full-voltage magnetic.
 - 3. Reduced-voltage solid state.
 - 4. Multispeed.
- B. Related Section:
 - 1. Division 26 Section "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.
 - e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
 - f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For enclosed controllers 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. Routine maintenance requirements for enclosed controllers and installed components.
 - 2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - 3. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.
- F. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

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1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than **minus 22 deg F (minus 30 deg C)** and not exceeding **104 deg F (40 deg C)**.
 - 2. Altitude: Not exceeding **6600 feet (2010 m)**.
- B. Comply with NFPA 70E.

1.9 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

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- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D; a brand of Schneider Electric.
 - 2. Configuration: Nonreversing.
 - 3. Flush or surface mounting.
 - 4. Red pilot light.

- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D; a brand of Schneider Electric.
 - 2. Configuration: Nonreversing.
 - 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
 - 4. Surface mounting.
 - 5. Red pilot light.

- D. Magnetic Controllers: Full voltage, across the line, electrically held.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D; a brand of Schneider Electric.
 - 2. Configuration: Nonreversing.
 - 3. Contactor Coils: Pressure-encapsulated type.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - 4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 - 5. Control Circuits: 24 or 120-V ac, as required by the control circuit; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 100 VA.

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6. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
 - e. Analog communication module.
 7. N.C./N.O., isolated overload alarm contact.
 8. External overload reset push button.
- E. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D; a brand of Schneider Electric.
 2. Fusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
 3. Nonfusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
 4. MCP Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
 - d. N.C./N.O. alarm contact that operates only when MCP has tripped.
 - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
 5. MCCB Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.

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- b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
- e. N.C./N.O. alarm contact that operates only when MCCB has tripped.

2.2 MULTISPEED MAGNETIC CONTROLLERS

- A. General Requirements for Multispeed Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Multispeed Magnetic Controllers: Two speed, full voltage, across the line, electrically held.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D; a brand of Schneider Electric.
 - 2. Configuration: Nonreversing; consequent pole or two winding types as required by the motor being controlled.
 - 3. Contactor Coils: Pressure-encapsulated type.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - 4. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 - 5. Control Circuits: 24 or 120-V ac, as required by the control circuit; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 100 VA.
 - 6. Compelling relays shall ensure that motor will start only at low speed.
 - 7. Accelerating timer relays shall ensure properly timed acceleration through speeds lower than that selected.
 - 8. Decelerating timer relays shall ensure automatically timed deceleration through each speed.
 - 9. Antiplugging timer relays shall ensure a time delay when transferring from FORWARD to REVERSE and back.
 - 10. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

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11. N.C./N.O., isolated overload alarm contact.
12. External overload reset push button.

2.3 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
 1. Dry and Clean Indoor Locations: Type 1.
 2. Outdoor Locations: Type 3R.
 3. Kitchen and Wash-Down Areas: Type 4X, stainless steel.
 4. Other Wet or Damp Indoor Locations: Type 4.
 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.4 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.
 - a. Push Buttons: Covered, lockable types; maintained or momentary as indicated.
 - b. Pilot Lights: LED types; colors as indicated; push to test.
 - c. Selector Switches: Rotary type.
- B. N.C./N.O. auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- E. Cover gaskets for Type 1 enclosures.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or

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mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

- B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch (100-mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Seismic Bracing: Comply with requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible-switch enclosed controller.
- F. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- G. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- I. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

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3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's central control system. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
 - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 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. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect and Owner before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

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- E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect and Owner before increasing settings.
- D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.
- E. Set field-adjustable circuit-breaker trip ranges.

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

END OF SECTION 262913

SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Work includes the complete installation, electrical connections, testing, and commissioning of the Variable Frequency Drive systems (VFDs.)
- C. The contractor shall provide specified VFD harmonic mitigation and system testing as part of these VFD requirements.
- D. VFD harmonic mitigation equipment shall be included as part of the VFD package.

1.2 SUMMARY

- A. Section includes separately enclosed, pre-assembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.
- B. Related Sections:
 - 1. Division 26 Section "Motor-Control Centers" for VFCs installed in motor-control centers.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CE: Conformance Europeene (European Compliance).
- C. CPT: Control power transformer.
- D. EMI: Electromagnetic interference.
- E. IGBT: Insulated-gate bipolar transistor.
- F. LAN: Local area network.
- G. LED: Light-emitting diode.
- H. MCP: Motor-circuit protector.
- I. NC: Normally closed.
- J. NO: Normally open.
- K. OCPD: Overcurrent protective device.

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- L. PCC: Point of common coupling.
- M. PID: Control action, proportional plus integral plus derivative.
- N. PWM: Pulse-width modulated.
- O. RFI: Radio-frequency interference.
- P. TDD: Total demand (harmonic current) distortion.
- Q. THD(V): Total harmonic voltage demand.
- R. VFC: Variable-frequency motor controller.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.
- B. Custom Shop Drawings: (standard factory sales brochure/data is not acceptable) For each VFC indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
 - 1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Enclosure types and details.
 - d. Nameplate legends.
 - e. Short-circuit current (withstand) rating of enclosed unit.
 - f. Features, characteristics, ratings, and factory settings of each VFC and installed devices.
 - g. Specified modifications.
 - 2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.
- C. Harmonic Test Prototype Report: Submit prototype test report for each VFC and filter method combination for this project. Show total harmonic distortion levels in voltage and current for a range of frequencies: 25%, 50%, 75% and 100% of 60 Hz.
- D. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFCs. Show

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VFC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

- E. Qualification Data: For qualified testing agency.
- F. Seismic Qualification Certificates: For VFCs, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.
- G. Product Certificates: For each VFC, from manufacturer.
- H. Source quality-control reports.
- I. Field quality-control reports.
- J. Operation and Maintenance Data: For VFCs 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. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
 - 2. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - 4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
 - 5. Schematic drawings.
 - 6. Catalog sheets.
 - 7. Diagrams/pictures showing actual components and parts numbers.
 - 8. Test Certificates.
 - 9. Warranty information.
 - 10. Listing of service personnel responsible for warranty repairs.
- K. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.6 QUALITY ASSURANCE

- A. Provide UL 508 listing on assembled drive.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

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- 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. Comply with NFPA 70.
- E. Listed and carry the label of at least one of the following:
 - 1. UL.
 - 2. ETL.
- F. IEEE Compliance: Fabricate and test VFC according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than 14 deg F (minus 10 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C)
 - 3. Humidity: Less than 95 percent (noncondensing).
 - 4. Altitude: Not exceeding 6000 feet (1800 m).
- B. Comply with NFPA 70E
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.9 COORDINATION

- A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:
 - 1. Torque, speed, and horsepower requirements of the load.
 - 2. Ratings and characteristics of supply circuit and required control sequence.
 - 3. Ambient and environmental conditions of installation location.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

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1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 3 years minimum from date of vendor start-up.
 - 2. Warranty shall include the entire VFD system including harmonics.

1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Indicating Lights: Two of each type and color installed.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following approved suppliers (manufacturers):
 - 1. Energy Management Corporation (Mitsubishi) Motor Drives International
 - 2. Long Building Environments/Bisel (Yaskawa)
 - 3. Midgley-Huber (ABB)
 - 4. Dan Foss
- B. General Requirements for VFCs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.
- C. Application: Constant torque and variable torque.
- D. VFC Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means, overcurrent and overload protection, and harmonic filter; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
 - 1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
 - 2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
 - 3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

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- E. Do not provide manual bypass within VFC.
- F. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- G. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- H. Unit Operating Requirements:
 - 1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of VFC input voltage rating.
 - 2. Input AC Voltage Unbalance: Not exceeding 3 percent.
 - 3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
 - 4. Minimum Efficiency: 97 percent at 60 Hz, full load.
 - 5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
 - 6. Minimum Short-Circuit Current (Withstand) Rating: Equal to or greater than the AIC rating of gear feeding the drive. Where AIC rating is unknown a minimum of 65 kA shall be provided.
 - 7. Ambient Temperature Rating: Not less than 14 deg F (minus 10 deg C) and not exceeding 104 deg F (40 deg C).
 - 8. Ambient Storage Temperature Rating: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C).
 - 9. Humidity Rating: Less than 95 percent (noncondensing).
 - 10. Altitude Rating: Not exceeding 6000 feet (1800 m). Ensure drive is derated for elevation above 3300 feet and rated at full capacity up to 5000 feet elevation.
 - 11. Vibration Withstand: Comply with IEC 60068-2-6.
 - 12. Overload Capability for high overload capacity (constant torque) drives: 1.1 times the base load current indefinitely; 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
 - 13. Overload Capability for normal overload capacity (variable torque) drives: 1.1 times the base load current indefinitely; 1.2 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
 - 14. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
 - 15. Speed Regulation: Plus or minus 5 percent.
 - 16. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
 - 17. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- I. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.
- J. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
 - 1. Signal: Electrical.
 - 2. Signal: Pneumatic.

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- K. Internal Adjustability Capabilities:
 - 1. Minimum Speed: 5 to 25 percent of maximum rpm.
 - 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 - 3. Acceleration: 0.1 to 999.9 seconds.
 - 4. Deceleration: 0.1 to 999.9 seconds.
 - 5. Current Limit: 30 to minimum of 150 percent of maximum rating.

- L. Self-Protection and Reliability Features:
 - 1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
 - 2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
 - 3. Under- and overvoltage trips.
 - 4. Inverter overcurrent trips.
 - 5. VFC and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
 - 6. Critical frequency rejection, with three selectable, adjustable deadbands.
 - 7. Instantaneous line-to-line and line-to-ground overcurrent trips.
 - 8. Loss-of-phase protection.
 - 9. Reverse-phase protection.
 - 10. Short-circuit protection.
 - 11. Motor overtemperature fault.

- M. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

- N. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

- O. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

- P. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

- Q. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

- R. Integral Input Disconnecting Means and OCPD: Motor circuit protector type circuit breaker that is externally operable from the outside of the VFD panel.

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1. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.
 2. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
 3. NC/NO alarm contact that operates only when circuit breaker has tripped.
- S. VFD shall include Interlock capabilities with local disconnect switch at motor when VFD is remote (not within sight) of motor(s) being controlled.
- T. Permanently label all internal wiring.
- U. Control voltage shall be 120V.
- V. Provide fire alarm fan/VFD shutdown input.
- W. Doors must not require special tools to open.
- X. Provide a terminal block for VFD feeders to connect to, provide factory wiring between terminal block and VFD output terminals.

2.2 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators or other acceptable status indication displaying the following conditions:
1. Power on.
 2. Run.
 3. Overvoltage.
 4. Line fault.
 5. Overcurrent.
 6. External fault.
 7. VFD Fault light
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
 2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
 - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- C. Historical Logging Information and Displays:
1. Not required, BAS shall be used to track and time stamp.
- D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

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1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (V dc).
 9. Set point frequency (Hz).
 10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
1. Electric Input Signal Interface:
 - a. A minimum of two programmable analog inputs: 0- to 10-V dc; 4- to 20-mA dc.
 - b. A minimum of six multifunction programmable digital inputs.
 2. Pneumatic Input Signal Interface: 3 to 15 psig (20 to 104 kPa).
 3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:
 - a. 0- to 10-V dc.
 - b. 4- to 20-mA dc.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 4. Output Signal Interface: A minimum of two programmable analog output signal(s) (0- to 10-V dc and 4- to 20-mA dc), which can be configured for any of the following:
 - a. Output frequency (Hz).
 - b. Output current (load).
 - c. DC-link voltage (V dc).
 - d. Motor torque (percent).
 - e. Motor speed (rpm).
 - f. Set point frequency (Hz).
 5. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - a. Motor running.
 - b. Set point speed reached.
 - c. Fault and warning indication (overtemperature or overcurrent).
 - d. PID high- or low-speed limits reached.
 6. Remote Switch
 7. Termination points on a terminal strip for field connections:
 - a. Safeties Interlock (N.C. contacts located remote)
 - b. Remote Start/Stop Contact (N.O. contacts located remote).
 - c. Remote VFC Fault Contacts (N.C.).
 - d. Remote VFC Enable Contacts (N.O.).
 - e. Remote Electronic Signal Input.
- F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
1. Number of Loops: Two.

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- G. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFC status and alarms and energy usage. Allows VFC to be used with an external system within a multidrop LAN configuration; settings retained within VFC's nonvolatile memory.
 - 1. Network Communications Ports: Ethernet and RS-422/485.
 - 2. Embedded BAS Protocols for Network Communications: Provide capability for all of the following, and coordinate exact type with the BAS installer; protocols accessible via the communications ports:
 - a. ASHRAE 135 BACnet
 - b. Modbus/Memobus

2.3 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: Factory installed integral to the VFC enclosure as one UL listed assembly:
 - 1. Motors Less than 15 HP: AC line reactors with a minimum of 3% impedance and DC choke.
 - 2. Motors 15 HP and Larger shall have harmonic correction of 12% THID current or less and 3% voltage distortion or less at the input of the VFD terminals. This shall be accomplished by using Harmonic filters or a minimum of 12 pulse drive that will comply with the power quality performance requirements. A harmonic test will be performed by an independent third party. If the manufacturer fails to meet the harmonic limits, they will replace the VFD system at their expense with another VFD system meeting these requirements.
- B. Output Filtering: Integral output filter where VFC is located greater than 50' (15 m) from the motor it is controlling.
- C. Filter/Transformers shall be factory wired.

2.4 OPTIONAL FEATURES

- A. Multiple-Motor Capability: VFC suitable for variable-speed service to multiple motors. Overload protection shuts down VFC and motors served by it, and generates fault indications, when overload protection activates.
 - 1. Configure to allow two or more motors to operate simultaneously at the same speed; separate overload relay for each controlled motor.

2.5 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1 filtered and force ventilated.
 - 2. Outdoor Locations: Type 3R filtered and force ventilated.
 - 3. Kitchen and wash-Down Areas: Type 4X.
 - 4. Other Wet or Damp Indoor Locations: Type 3R filtered and force ventilated.
- B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

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2.6 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
 - 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.
 - a. Push Buttons: Covered; maintained or momentary.
 - b. Pilot Lights: LED types; push to test.
 - c. Selector Switches: Rotary type.
- B. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
 - 1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.
- D. Cooling Fan and Exhaust System: NEMA 1 enclosure for VFD's beyond 25 HP supply fan, with composite intake and exhaust grills and filters; 120 -V ac; obtained from integral CPT.
- E. Ventilated, NEMA 1 enclosure with filter for VFD's 25 HP and less.
- F. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- G. Spare control-wiring terminal blocks ; wired.

2.7 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
 - 1. Test each VFC while connected to a motor that is comparable to that for which the VFC is rated.
 - 2. Verification of Performance: Rate VFCs according to operation of functions and features specified.
- B. VFCs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

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- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Wall-Mounting Controllers: Install VFCs on walls with tops at uniform height and with disconnect operating handles not higher than **79 inches (2000 mm)** above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Floor-Mounting Controllers: Install VFCs on **4-inch (100-mm)** nominal thickness concrete base. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than **79 inches (2000 mm)** above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.
 - 1. Curbs and roof penetrations are specified in Division 07 Section "Roof Accessories."
 - 2. Structural-steel channels are specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Seismic Bracing: Comply with requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

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- G. Install fuses in each fusible-switch VFC.
- H. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- I. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- J. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- K. The variable frequency drive inverter unit shall be mounted on a removable panel to facilitate maintenance.
- L. New filters shall be installed into VFD units just prior to substantial completion, when system maintenance will become the owner's responsibility.
- M. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, [control signal used,]and components; provide warning signs.
 - 2. Label each VFC with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Provide all conduit and wiring to interlock VFD with remote disconnect switches.
- C. Bundle, train, and support wiring in enclosures.
- D. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified third party testing agency to perform tests and inspections.

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- B. 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.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect and Owner before starting the motor(s).
 - 5. Measure total harmonic distortion levels for voltage and current at the input terminals to the VFC. Record values for a range of frequencies: 25%, 50%, 75% and 100%.
 - 6. Test each motor for proper phase rotation.
 - 7. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 8. Include all measurements in the harmonic distortion report. Provide report to Engineer for review.
 - 9. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 10. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. VFCs will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies the VFC and describes test results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

- A. Reserve project budget allowance of \$300 per drive for testing by USU facilities. USU will measure and verify power quality of VFD. Deviations from minimum power quality performance specified will be remedied by the Contractor at no additional cost the Owner until power quality measurements comply with specifications.
- B. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

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- C. Replace Filters with new at substantial completion.

3.7 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect and Owner before increasing settings.
- D. Set field-adjustable circuit-breaker trip ranges.
- E. Set field-adjustable pressure switches.

3.8 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 262923

SECTION 265100 - INTERIOR LIGHTING

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. Interior lighting fixtures, lamps, and ballasts.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Lighting fixture supports.
- B. Related Sections:
 - 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Section 260936 "Modular Dimming Controls" for architectural dimming systems.
 - 3. Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
 - 4. Section 262726 "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting fixture, including ballast housing if provided.
 - 1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Emergency lighting units including battery and charger.

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3. Ballast, including BF.
 4. Energy-efficiency data.
 5. Air and Thermal Performance Data: For air-handling lighting fixtures. Furnish data required in "Action Submittals" Article in Section 233713 "Diffusers, Registers, and Grilles."
 6. Sound Performance Data: For air-handling lighting fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Section 233713 "Diffusers, Registers, and Grilles."
 7. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
 8. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
 - a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
 - b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. If project is LEED Certified or to be LEED Certified, product data submittals shall also include the following information and highlighted in submittal:
1. Luminance Chart/Graph showing fixture utilizes less than 7500 cd/m² between 45 and 90 degree from nadir.
 - a. Exceptions include wall wash and indirect only type fixtures.
 2. Unified glare rating
 3. CRI of 80 or higher
 - a. Exceptions include site lighting, accent or colored lighting
 4. Rated life, L70, of at least 24,000 hours
- C. Finish and Color Submittal: Provide a complete finish and color submittal package with all finish and color options for each fixture available for the project. Architect shall provide selections based on this separate submittal.
- D. Shop Drawings: For nonstandard or custom lighting fixtures. 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.
- E. Seismic Qualification Certificates: For lighting fixtures, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

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- F. Samples: For each lighting fixture indicated in the Interior Lighting Fixture Schedule. Each Sample shall include the following:
 - 1. Lamps and ballasts, installed.
 - 2. Cords and plugs.
 - 3. Pendant support system.
- G. Installation instructions.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Lighting fixtures.
 - 2. Suspended ceiling components.
 - 3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches (305 mm) of the plane of the luminaires.
 - 4. Ceiling-mounted projectors.
 - 5. Structural members to which suspension systems for lighting fixtures will be attached.
 - 6. Other items in finished ceiling including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Smoke and fire detectors.
 - e. Occupancy sensors.
 - f. Access panels.
 - 7. Perimeter moldings.
- B. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fixtures/Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

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3. LED-fixture-mounted, emergency battery pack: One for every 20 emergency lighting unit.
4. Ballasts: One for every 100 of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.
- D. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- E. Mockups: Provide interior lighting fixtures for room or module mockups complete with power and control connections.
 1. Obtain Architect's approval of fixtures for mockups before starting installations.
 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.10 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
 2. Warranty Period for Emergency Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.
 3. Acrylic Lenses, Anti-Yellowing: 5 years from date of Substantial Completion if acrylic lenses have any noticeable sign of yellowing.

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4. Warranty Period for LED Luminaires: 5 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining 4 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products indicated.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- H. Diffusers and Globes:
 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least **0.125 inch (3.175 mm)** minimum unless otherwise indicated.
 - b. UV stabilized.
 2. Glass: Annealed crystal glass unless otherwise indicated.
- I. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 1. Label shall include the following lamp and ballast characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
 - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

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- d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
 - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
 - f. CCT and CRI for all luminaires.
- 2.

2.3 LED LAMPS AND DRIVERS

- A. Approved Manufacturers for Luminaires shall be as scheduled.
- B. Approved Manufacturers- LEDs
 1. General Electric
 2. Philips
 3. Osram
 4. Cree
 5. Xicato
 6. Nichia
- C. Approved Manufacturers- Drivers
 1. General Electric.
 2. Philips.
 3. Osram / Sylvania.
 4. Lutron
 5. EldoLED
 6. Thomas Research
- D. Lumen output shall be Luminaire Lumens or Delivered Lumens. Source lumens shall not be used, per IES LM-79 and LM-80.
- E. Inrush current shall be negligible. Maximum allowed is 30mAs.
- F. THD: THD shall not exceed 20% at full load.
- G. Minimum driver efficiency shall be 86% at 65% rated load.
- H. Maximum off-state power consumption 0.5w.
- I. Compliant with FCC 47 CFR Part 15 A for Residential applications and B for Commercial applications.
- J. Luminaire shall be NRTL Listed at intended operating temperature.
- K. Photometry shall be measured or absolute photometry. Derived or calculated photometry shall not be provided for consideration.
- L. Drivers for Solid State Lighting Sources: Comply with UL 8750 and be so recognized.
- M. Ballast Circuit: Constant-current or constant voltage as required by the LED assembly.
- N. High power factor >.90

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- O. Driver and Led modules shall operate the solid state light source in a constant manner, performing without measurable flicker below 25kHz along entire range of dimming.
- P. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C).
- Q. Rated and UL / ETL tested ambient operating temperature:104 deg F (40 deg C).
- R. CRI (Ra) shall be based on CIE/IES definition using 8 color criteria. Comply with R9 value, if specified. Minimum CRI Ra- 82 or as specified.
- S. Individual LEDs shall be tested in compliance with IES LM-79-08. The complete LM-79 report shall be available if requested.
- T. Chromaticity tolerance shall be 2 MacAdam ellipses for interior applications and 6 MacAdam Ellipses for exterior applications. Rating shall be by ANSI/NEMA C78.377-2008.
- U. Rated life shall be as determined by IES LM-80-08 and IES TM-21-11. These full reports shall be available if requested.
- V. Only original Absolute Photometry in compliance with IES LM-79-08 shall be used to report solid state luminaire performance. Derived files are not acceptable.
- W. Do not exceed scheduled drive current. Open-circuit operation that will not reduce driver life.
- X. Dimming by DMX, DALI, PWM or CCR methods are approved, must be compatible with the control systems on the projects. Dimming range shall be from 100% to 1% of measured light output.
- Y. Dimming drivers shall be compatible with the control method shown on the drawings. All dimmed drivers shall use 0-10vdc control unless specified differently. Minimum level shall be 1% or as scheduled.
- Z. Low-Noise Ballasts: manufacturers' standard epoxy-encapsulated or noise suppressed modules designed to minimize audible fixture noise.
- AA. LED modules and drivers shall be replaceable in the field, LED modules shall have digitally traceable matching modules.

2.4 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
 - 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal

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- voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
 - 3. Master/Remote Sign Configurations:
 - a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply battery for power connection to remote unit.
 - b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery, and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.5 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
 - 1. Battery: Sealed, maintenance-free, lead-acid type.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
 - 7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
 - 8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - 9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

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2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: **1/2-inch (13-mm)** steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, **1/2-inch (13-mm)** steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, **12 gage (2.68 mm)**.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, **12 gage (2.68 mm)**.
- F. Rod Hangers: **3/16-inch (5-mm)** minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures:
 - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
 - 2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.
- D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
 - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than **6 inches (150 mm)** from at least two diagonal corners of lighting fixture and attach to building structure.
 - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two **3/4-inch (20-mm)** metal channels spanning and secured to ceiling tees.
 - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

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- E. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
 - 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
 - 5. Safety Cables: to prevent the fixture from falling if swaying breaks the pendant.
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.
- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
 - 1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION 265100

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SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

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. Provide a voice/alarm based notification system.
- B. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Magnetic door holders.
 - 7. Remote annunciator.
 - 8. Addressable interface device.
 - 9. Digital alarm communicator transmitter.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 SUBMITTALS

- A. General Submittal Requirements:
 - 1. In addition to the submittal to the Architect/Engineer, provide a complete submittal to the office of the Utah State Fire Marshal for review and

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- approval. Incorporate Fire Marshal's corrections prior to submitting to the Architect/Engineer.
2. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
 3. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified fire-alarm technician, Level IV minimum.
 - c. Licensed or certified by authorities having jurisdiction.
- B. Product Data: For each type of product indicated.
- 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.
 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 plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and 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. First paragraph below is defined in Division 01 Section "Submittal Procedures" as a "Delegated-Design Submittal." Retain if detector locations are not shown on Drawings. Coordinate with "Quality Assurance" and "Equipment Installation" articles. See Editing Instruction No. 9 in the Evaluations for discussion about detector locations. Professional engineer qualifications are specified in Division 01 Section "Quality Requirements."
 - 8.
- D. Qualification Data: For qualified Installer.
- E. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

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3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- F. Field quality-control reports.
- G. 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. Copy of NFPA 25.

- H. Software and Firmware Operational Documentation:
 1. Software operating and upgrade manuals.
 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
 1. Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

- 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.

- 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.

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- E. GUARANTEES:
 - 1. Furnish a three-year guarantee for all equipment, materials and installation, including all labor and transportation
 - 2. Emergency Response: The fire alarm equipment supplier shall provide an emergency response within four hours of any reported system failure to resolve the problem on a continuous basis.

1.8 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.9 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. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 2. Keys and Tools: One extra set for access to locked and tamperproofed components.
 - 3. Audible and Visual Notification Appliances: Quantity equal to 5 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 4. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Notifier

2.2 COMPLY WITH ALL USU FIRE ALARM STANDARDS AS NOTED BELOW, where any deviation exists USU standards shall govern.

(4) Equipment and Materials

- Use the following symbols for fire alarm drawings. For Design/Construction drawings use the monochrome symbols. For As-Built/Record drawings use the colored symbols.

- Approved fire alarm system vendors:
 - Notifier

(5) Design Requirements

- Provide battery backup capacity capable of operating system after a 48 hr outage x 15 minute alarm.
- For sprinkler system water gongs provide weatherproof horn/strobe 12' h above FDC, activated only by water flow and deactivated only by water flow cessation.
- Fire Alarm Central Panel (FACP) alarm reporting shall be via dry telephone pairs to the USU Fire Alarm Master Panel (FAMP). Do not provide fire alarm dialers. Run ¾" EMT and 2 conductor cable from fire panel (FACP) to building main telephone distribution closet (BDF).
- Provide one circuit per NAC
- The following items should be on or attached to the design drawings:
 - battery capacity calculations
 - visual device candela rating
 - audible device sound pressure rating and actual setting
 - I/O matrix
 - FCPS location and number
 - Sound pressure design analysis, calculations or modeling

(6) Implementation

- Prior to commencing construction, the contractor will visit an existing fire alarm installation with USU personnel to review how the details and requirements of this document are to be implemented.
- Prior to commencing construction, the contractor shall provide fire alarm shop drawings and equipment submittals to USU for review and approval. Include:
 - equipment and device cutsheets
 - battery calculations
 - visual device candela rating
 - audible device sound pressure rating and actual setting
 - I/O matrix
 - FCPS location and number
- Contractor shall request from USU a visual inspection of all fire alarm conduits prior to being concealed by sheetrock or other construction material.
- FACP device point labeling should be descriptive and accurate. For example: SMOKE (PHOTO) HALL BY RM 106B BSMT LEVEL 1.
- Devices shall be visibly labeled with the corresponding loop number and device address. Example: L2, L1D07.
- Device labels shall be applied to the fixed portion of the devices (device base rather than to removable device).
- Label devices with an adhesive type labeling tape.
- Contractor shall keep redline drawings current throughout the project showing:
 - conduit routing
 - location of all devices, relays, control modules
 - device connection order
 - device address

(7) Testing and Close-out

- Prior to final inspection contractor shall:
 - Conduct 100% pre-test of entire system.
 - Submit panel history print showing 100% testing
 - Submit Record of Completion. See NFPA 72 (4.5.1.2)

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FIRE ALARM SYSTEM RECORD OF COMPLETION
To be completed by the system installation contractor at the time of system acceptance and approval.

1. PROTECTED PROPERTY INFORMATION

Name of property: _____
 Address: _____
 Description of property: _____
 Occupancy type: _____
 Name of property representative: _____
 Address: _____
 Phone: _____ Fax: _____ E-mail: _____
 Authority having jurisdiction over this property: _____
 Phone: _____ Fax: _____ E-mail: _____

2. FIRE ALARM SYSTEM INSTALLATION, SERVICE, AND TESTING INFORMATION

Installation contractor for this equipment: _____
 Address: _____
 Phone: _____ Fax: _____ E-mail: _____
 Service organization for this equipment: _____
 Address: _____
 Phone: _____ Fax: _____ E-mail: _____
 Location of as-built drawings: _____ Location of historical test reports: _____
 Location of system operation and maintenance manuals: _____
 A contract for test and inspection in accordance with NFPA standards is in effect as of _____
 Contracted testing company: _____
 Address: _____
 Phone: _____ Fax: _____ E-mail: _____
 Contract expires: _____ Contract number: _____ Frequency of routine inspections: _____

3. TYPE OF FIRE ALARM SYSTEM OR SERVICE

NFPA 72 Chapter Reference of System Type: _____
 Name of organization receiving alarm signals with phone numbers (if applicable): _____
 Alarm: _____ Phone: _____
 Supervisory: _____ Phone: _____
 Trouble: _____ Phone: _____
 Entity to which alarms are retransmitted: _____ Phone: _____
 Method of retransmission of alarms to that organization or location: _____

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FIGURE 4.5.2.1 Record of Completion.

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FIGURE M-3: Record of Completion Form

- Acceptance tests for fire alarm systems shall include:
 - 48-hour x 15-minute battery back-up test
 - Visual inspection of all devices and conduit
 - Visual coverage of strobe annunciation
 - Measurement and verification of min/max sound levels
- Place a printed and bound copy of the record drawings in the FACP panel door.
- Prior to project close out, provide digital (dwg & pdf) and printed record drawings and O&M Manuals showing:
 - conduit routing
 - location of all devices, relays, control modules
 - device connection order
 - device address
 - equipment and device cutsheets
 - battery calculations
 - visual device candela rating
 - audible device sound pressure rating and actual setting
 - I/O matrix
 - FCPS location and number
 - panel programming information

- [device point report](#)

2.3 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
1. Manual stations.
 2. Heat detectors.
 3. Flame detectors.
 4. Smoke detectors.
 5. Duct smoke detectors.
 6. Verified automatic alarm operation of smoke detectors.
 7. Automatic sprinkler system water flow.
 8. Heat detectors in elevator shaft and pit.
 9. Fire-extinguishing system operation.
 10. Fire standpipe system.
- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
 2. Identify alarm at fire-alarm control unit and remote annunciators.
 3. Transmit an alarm signal to the remote alarm receiving station.
 4. Unlock electric door locks in designated egress paths.
 5. Release fire and smoke doors held open by magnetic door holders.
 6. Activate voice/alarm communication system.
 7. Recall elevators to primary or alternate recall floors.
 8. Activate emergency lighting control.
 9. Activate emergency shutoffs for gas and fuel supplies.
 10. Record events in the system memory.
 11. Mute and/or override the sports PA system
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Low-air-pressure switch of a dry-pipe sprinkler system.
 3. Elevator shunt-trip supervision.
 - 4.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of primary power at fire-alarm control unit.
 4. Ground or a single break in fire-alarm control unit internal circuits.
 5. Abnormal ac voltage at fire-alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at fire-alarm control unit or annunciator.

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- E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators.

2.4 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Unit:
 - 1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
 - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 - 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 - 3. Addressable control circuits for operation of mechanical equipment.
 - 4. Shall operate all alarm and auxiliary devices and close all fire and smoke doors.
 - 5. Shall detect the operation of any signal initiating device, display description of the device, and area of the alarm. Also shall print out alarm type, location, time, and date.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 - 1. Annunciator and Display: Liquid-crystal type, 3 line(s) of 80 characters, minimum.
 - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- C. Circuits:
 - 1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.
 - a. Initiating Device Circuits: Style D.
 - b. Notification Appliance Circuits: Style Z.
 - c. Signaling Line Circuits: Style 6.
 - d. Quantity of addressable devices shall not exceed 75% of signaling line circuit capacity.
 - 2. Serial Interfaces: RS-232 ports for printers.
- D. Smoke-Alarm Verification:

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1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
 2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
 - 3.
 4. Sound general alarm if the alarm is verified.
 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- E. Notification Appliance Circuit: Operation shall sound in a temporal pattern.
- F. Elevator Recall:
1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
 2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
 3. Heat detector in elevator machine room shall shunt trip the power to the elevator, after the elevator has moved to the recall floor.
 4. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.
- H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.
- I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- J. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.
1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.

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- a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
 - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- K. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- L. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- M. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch .
1. Batteries: Sealed, valve-regulated, recombinant lead acid.
 2. Shall be a gel cell type. Must meet requirements outlined in Rules and Regulations, plus an addition 25 percent ampere-hour capacity. U of U Projects
- N. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.5 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in white with molded red raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

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1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.

2.6 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 1. Comply with UL 268; operating at 24-V dc, nominal.
 2. Detectors shall be four-wire type.
 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
 7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
 - c. Provide multiple levels of detection sensitivity for each sensor.
- B. Photoelectric Smoke Detectors:
 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
- C. Ionization Smoke Detector:
 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.

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- d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
- D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
 3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
 4. Each sensor shall have multiple levels of detection sensitivity.
 5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
 6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.
 7. Duct detectors shall be installed in readily accessible locations. If a duct detector cannot be installed in a readily accessible location, these shall be equipped with remote indicating lamps per NFPA 72.

2.7 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.8 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.
- B. General Requirements for Notification Appliances: Connected to notification appliance signal circuits zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a

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sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

- D. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
 - 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 - 2. Mounting: Wall mounted unless otherwise indicated.
 - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - 4. Flashing shall be in a temporal pattern, synchronized with other units.
 - 5. Strobe Leads: Factory connected to screw terminals.
 - 6. Mounting Faceplate: Factory finished, white as selected by the Architect.
- E. Voice/Tone Notification Appliances:
 - 1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
 - 2. High-Range Units: Rated 2 to 15 W.
 - 3. Low-Range Units: Rated 1 to 2 W.
 - 4. Mounting: Semirecessed.
 - 5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.9 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
 - 1. Manufacturer: GE Interlogix ESL DH Series
 - 2. Electromagnet: Requires no more than 3 W to develop 35-lbf holding force.
 - 3. Wall-Mounted or Floor-Mounted Units as directed by architect: Flush mounted where possible.
 - 4. Rating: Double Coil, Dual rated 24-Vdc/Vac and 120 Vac.
- B. Material and Finish: Match door hardware.

2.10 FDC NOTIFICATION APPLIACE

- A. Provide FDC notification appliance located outside above the FDC location.
- B. Notification appliance shall be:
 - 1. Manufacturer: Potter SASH-24
 - 2. Weatherproof, horn/strobe, 24VDC

2.11 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 - 1. Mounting: Flush cabinet, NEMA 250, Type 1.

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- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.12 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal to external system or equipment.

2.13 REMOTE MONITORING

- A. Provide a 1" conduit from fire alarm control panel back to main telecom room for remote monitoring of the fire alarm system through the campus monitoring system.

2.14 DEVICE FINISH

- A. Factory fabricated and finished in: white with red lettering.

2.15 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other devices located in the gymnasium.
 1. Factory fabricated and furnished by manufacturer of device.
 2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install wall-mounted fire-alarm control units with tops of cabinets not more than 72 inches (1830 mm) above the finished floor. Retain first subparagraph below if Project requires seismic bracing. Coordinate with Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
 1. Install seismic bracing. Comply with requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
 2. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 3. Install anchor bolts to elevations required for proper attachment to supported equipment. Retain first paragraph below for equipment supported on finished floor.
- C. Smoke- or Heat-Detector Spacing:

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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 (9 m)**.
 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 (1 m)** from air-supply diffuser or return-air opening.
 6. Lighting Fixtures: Locate detectors not closer than **12 inches (300 mm)** from any part of a lighting fixture.
- D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- E. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Locate detectors within 12" of sprinkler heads.
- F. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- G. Audible Alarm-Indicating Devices: Install not less than **6 inches (150 mm)** below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least **6 inches (150 mm)** below the ceiling and at least 84" above the floor.
- I. Pull Station height shall be not more than 48 inches (1200 mm) above the floor level to the bottom of the device.
- J. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- K. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than **72 inches (1830 mm)** above the finished floor.
- L. Annunciator: Install with top of panel not more than **72 inches (1830 mm)** above the finished floor. Coordinate paragraph below with Drawings. Wind speed is usually a requirement of the applicable building code.
- M.

3.2 WIRING INSTALLATION

- A. Wiring Method: Install all cables and wiring in metal raceways according to Division 26 Section "Raceway and Boxes for Electrical Systems." Conceal raceway except in unfinished spaces and as indicated.

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- B. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by the manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- C. Cable Taps: Use numbered terminal strips in junction, pull and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- D. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red where concealed.
 - 1. Comply with campus color-code standard for fire alarm system wiring.
- E. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signal from other floors or zones.
- F. Wiring to Remote Alarm Transmitting Device: **1-inch (25-mm)** conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.
- G. All necessary provisions shall be made for automatic reporting of all alarms from the project fire alarm system to the remote station receiving console in Building 301 via leased telephone lines. The contractor will provide a conductor pair run in conduit from the fire alarm panel to the telephone panel and will make the final connection to the desired leased telephone line. The contractor will inform the proper authorities (Facilities Management) when the phone line is ready to be connected. U of U Project
- H. Concerning NAC the Horn and strobe circuits shall be separate. The horns shall have a temporal pattern signal. IDC, NAC and SLC wiring shall have independent feeds and returns from the panel to form a loop.
- I. FDC notification appliance shall be hard wired through the flow switch and powered by the fire alarm 24 VDC circuit. The appliance shall operate upon water flow and be silenced only upon cessation of water flow.
- J. Magnetic door hold open devices shall be powered from and controlled by the fire alarm panel through the 24 VDC circuit. Power shall be maintained during normal operation to the mag-hold-open device and power shall be removed upon initiation of the fire alarm system releasing the doors. Magnetic door hold open devices shall be not be controlled through fire alarm control modules they shall be powered and controlled directly from the fire alarm panel.

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- K. Distributed Antenna Systems (DAS). Tie in all DAS alarms per manufacturer instructions to fire alarm systems. Provide Monitor Relays as required for system.

3.3 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 (1 m)** from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
 - 2. Alarm-initiating connection to sports PA system for muting and/or override of PA system.
 - 3. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 4. Door hold open devices on designated doors.
 - 5. Alarm-initiating connection to elevator recall system and components.
 - 6. Alarm-initiating connection to activate emergency lighting control.
 - 7. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - 8. Supervisory connections at valve supervisory switches.
 - 9. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 - 10. Supervisory connections at elevator shunt trip breaker.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.5 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.

3.6 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. 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.

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- 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.
 - 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals 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.
- 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.
- G. All information pertaining to the Facility's fire alarm system shall be supplied to the facilities managers. This information shall include everything necessary to change the fire alarm program themselves. The minimum amount of information required is:
 - a. CAD drawing files of building fire alarm map.
 - b. CAD drawing files of "as built" fire alarm components and point to point connections.
 - c. CAD drawing files of "as built" drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of equipment.
 - d. General configuration programming
 - e. Job specific configuration programming.
 - f. Tutorial file on complete programming of fire alarm system.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

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- I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111