University of Utah
Building 303 Seismic Upgrade
Phase 4-VE

U o U Project # 22508

Salt Lake City, Utah 84123

Specifications

Permit Set

October 10, 2022

FFKR ARCHITECTS

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The University of Utah
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GENERAL CONDITIONS

September 1, 2020

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The University of Utah
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G E N E R A L C O N D I T I O N S

September 1, 2020

THESE GENERAL CONDITIONS ("General Conditions") are part of and subject to the Contractor's Agreement (defined below) between University of Utah (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 University to act on behalf of University 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 University, references in these General Conditions to A/E shall be deemed to refer to University'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 University 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 Executive 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 University and Contractor, issued after the execution of the Contractor's Agreement on University'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 University, 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 University 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 University 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 Design and Construction Support of the U Facilities department of the University of Utah, unless the context requires otherwise. Director may include a designee selected by the Director for a particular function described in the Contract Documents.

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 Chief Facilities Officer of the University of Utah 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 University.

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 University that authorizes Contractor to commence Work. It shall be deemed issued upon being sent by University 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 University 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 University 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 University or subcontractors or sub-subcontractors of a separate contractor retained by University.

SUBSTANTIAL COMPLETION. "Substantial Completion" and its derivatives means the date certified in accordance with Section 9.2 when the Work, or a designated portion thereof, is sufficiently complete, and any lack of completion or performance does not materially interfere with University's intended use of the Work, in accordance with the Contract Documents, so that University can occupy and use the Work for its intended use. University's "intended use" or "occupy" as used in this definition, shall include any intended use or occupation by any agency or entity that University intends to use or occupy the Work.

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.

UNIVERISTY. "University" means the University of Utah, Unless the context requires otherwise, University is the "Owner" as that term is commonly understood in the construction industry.

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. University.

2.1 INFORMATION AND SERVICES REQUIRED OF UNIVERSITY.

2.1.1 UNIVERSITY'S REPRESENTATIVE. University shall designate a representative authorized to act on behalf of University with respect to the Work ("University's Representative"). Unless the context requires otherwise, "University's Representative" is the "Owner's representative" as that term is commonly understood in the construction industry. University'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. University and University'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 University's judgment was executed improperly. University shall be the final interpreter of the Contract Documents; the decision of University in the absence of arbitrary or capricious conduct shall be conclusive. Notwithstanding anything to the contrary in the Contract Documents, University's approval shall not relieve Contractor of Contractor's sole responsibility for the Work.

2.1.2 SPECIALISTS AND INSPECTORS. University shall provide building inspection services in accordance with the applicable building codes, including routine and special inspections unless otherwise noted in the Contract Documents. University 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, University 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 University 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 University 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 University and shall promptly provide written notice to University 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, University shall endeavor to furnish information or services under University'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, University shall provide or make available to Contractor, free of charge, paper or electronic copies of Contract Documents, as determined by University, as are reasonably necessary for execution of the Work. University's website may also provide Contract Documents for the Work.

2.2 CONSTRUCTION BY UNIVERSITY OR BY SEPARATE CONTRACTORS.

2.2.1 UNIVERSITY'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS. University 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 University and the separate contractors or subcontractors retained by University 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 University and separate contractors or subcontractors.

2.2.3 COORDINATION OF SCHEDULES. Contractor shall cooperate with University and any separate contractors and subcontractors hired by University 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 University, all separate contractors and subcontractors, and their activities in the vicinity of the Work site.

2.2.4 REPORTING PROBLEMS TO UNIVERSITY. If part of Contractor's Work depends on work by University or a separate contractor, Contractor shall, prior to proceeding with that portion of the Work, promptly report in writing to University any apparent defects in workmanship of the work of University 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 University'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 University or any separate contractors or subcontractors, Contractor shall promptly remedy such damage and shall use all reasonable efforts to promptly negotiate a settlement with University 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 University in administering the Contract in accordance with the Contract Documents. The A/E shall have authority to act on behalf of University, but only to the extent provided in the Contract Documents and/or A/E's agreement with University.

3.1.2 SITE VISITS.

3.1.2.1 Site visits or inspections by the A/E or University 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 University a written report subsequent to each site visit detailing the visit.

3.1.3 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION. Except as authorized by University or as otherwise provided in the Contract Documents, including these General Conditions, the A/E and Contractor shall communicate through University 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 University.

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 University'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 University'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 University, 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 University, and University 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 University. 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 University, and require all Subcontractors to release, indemnify, hold harmless, and defend University, 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 University'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 University and shall at once report to University and A/E all errors, omissions, inconsistencies and/or ambiguities discovered. Contractor shall not be liable to University 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 University and A/E. If Contractor performs any Work without such notice to University 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 University and A/E all errors, omissions, inconsistencies and/or ambiguities discovered. If Contractor performs any Work without such notice to University 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 University 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, University 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 University 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 University, 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 University 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 University and the public, Contractor shall immediately replace the person upon receipt of University'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 University 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 University or University's agents in University'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 University 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 University, University'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 University.

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 University 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 University 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 University and the A/E for approval, as it may be modified with University's consent. Unless and except to the extent that preliminary Work at the Work site is authorized in writing by University, Contractor shall not prematurely commence the Work at the Work site or elsewhere until University 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 University when Contractor considers the entire Work to be completed. University 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 University.

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

4.6.2.4 University 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 University. 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 University.

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 University, other contractors, utilities, and other third parties that may affect or be affected by Contractor shall be included.

4.6.4.2 If University 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 University);

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 University, 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 University 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, University, A/E, and Contractor shall review Contractor's schedule compared to the Work completed. The amount of Work completed shall be approved by University 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 University the schedule with the Application for Payment; all of which shall be in accordance with University's approval. All updates shall be provided in electronic and hard copy formats. At each scheduled meeting with University, Contractor shall provide a four week look ahead, with long lead items identified. If the Work is not on schedule, Contractor shall immediately advise University 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 University'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 University 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 University 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 University, 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, University does not agree with the request, University 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 University 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 University 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 University; or separate contractors retained by University; or by a Force Majeure Delay (defined below) that University 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 University, 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 University 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 University and to the extent accepted by University;

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 University 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 University 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 University 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, University 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 University 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. University 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, University 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 University 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 University.

4.6.14.5 Notwithstanding any other provision of these General Conditions, the availability of liquidated damages to University shall not limit University'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 UNIVERSITY'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 University 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 University 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 University, 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, University 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 University 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. University 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 University 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 University 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 University 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 University 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 University 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 University 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 University for any and all losses, costs, and/or expenses incurred by University 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 University 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 University 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 University a separate agreement wherein the Design Professional shall expressly contract with University 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 University 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 University or University'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 University'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. University shall secure and pay for all necessary rights of access to the Work site. Contractor shall comply with all stipulations provided by University 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 University 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 University.

4.10 ACCESS TO WORK. Contractor shall provide University 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 University 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 University 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, University), 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 University reserves the right to reject on reasonable ground any Subcontractor. Contractor shall not contract with any person or entity to whom University 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 University.

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

5.1.2.1.1 If University 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 University 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 University shall be added to the SDI by a financial interest endorsement reasonably acceptable to University at no cost to University;

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 University 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 University 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 University.

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 University and the A/E.

5.2.3 RIGHTS. Each Subcontractor agreement shall preserve and protect the rights of University 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 University 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 University.

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 UNIVERSITY. Contractor contingently assigns each Subcontractor agreement with a Subcontractor for a portion of the Work to University, provided that the assignment is effective only after termination of the Contractor's Agreement by University for cause pursuant to Section 12.2 or stoppage of the Work by University pursuant to Section 12.5, and only for those Subcontractor agreements that University accepts by notifying the Subcontractor in writing. Contractor shall remain liable for all obligations incurred under assigned Subcontractor agreements prior to University'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 University 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 University.

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 University 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, University 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 University 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 University 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 University. 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 University and the A/E by phone with a follow-up email. Contractor shall resume the Work upon the direction of University. Contractor shall ensure cooperation with any University-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 University, 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 University 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 University 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 University. The A/E shall prepare Change Orders and Construction Change Directives with specific documentation and data for University'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 University or Contractor, the applicable unit prices may be equitably adjusted.

7.1.5 CONCEALED OR UNKNOWN CONDITIONS. Contractor must file a written notice with University 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 University 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 University 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 University 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 University 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 University 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 University, 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 University.

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

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

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

7.2.2.1.3 If University, after considering any input by the A/E, disagrees with Contractor's PCO, University 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 University's position in regard to a Contract Price and/or Contract Time adjustment or if a PCO is denied by University, 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 University in the Construction Change Directive, if any, or denial of the PCO. Such waiver shall entitle University 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 University has conveyed to Contractor University'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 University 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 University, 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 University 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 UNIVERSITY. University 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 University. If a proposal is not timely provided by Contractor, University 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. University, 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 University disagrees with Contractor's proposal, after considering any input from the A/E, University 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 University'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 University in the Construction Change Directive, if any. Such waiver shall entitle University 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 University has conveyed to Contractor University'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 University, including any terms mandated by unit price agreements or other terms of the Contract Documents.

7.4.2 UNIVERSITY 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 University 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 University 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 University, 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, University reserves the right to unilaterally issue, in University's sole discretion, a Construction Change Directive that requires Contractor to proceed with a change in the Work. University 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 University 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 UNIVERSITY. Pending the final determination of the increase in the Contract Price, if any, associated with a Construction Change Directive, University 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 University 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 University or an issue concerning time or money, Contractor shall file a PRE as a prerequisite for any consideration of the issue by University. The labeling of the notice or request shall not preclude the consideration of the issue by University.

7.7.2 TIME FOR FILING. The PRE must be filed in writing with University 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 University'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 University;

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 University.

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 University; 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 University 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 University, 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 University;

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 University's PRE process to the extent the issue is reasonably related to the performance of University or an entity for which University 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 University. In order to be eligible for University'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. University 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 University in reviewing the issue;

7.7.5.1.7 University shall not be obligated to consider any submission which is not in accordance with any provision of this Section 7.7;

7.7.5.1.8 The Subcontractor may accompany Contractor in participating with University regarding the PRE raised by the Subcontractor. University 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. University 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 University, Contractor shall proceed diligently with performance of the Work and University shall continue to make payments of undisputed amounts in accordance with the Contract Documents.

7.7.8 DECISION. University shall issue to Contractor, and any other third party brought into the process by University as being potentially liable to University, 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 University 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 University.

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 University 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 University 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 University.

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 University 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 University, may submit a Claim in accordance with this Section 7.8 as a prerequisite for any further consideration by University 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 University, 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 University within the same timeframe and with the same content requirements as required of a Claim submitted by Contractor under this Section 7.8.2. University 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 University 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, 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 University 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 University, 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 University 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 University as being liable to University.

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 University.

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 University, settlement of a Claim by University 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) filing fee to University. 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 University in University'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 University's evaluation of performance.

7.8.14 REPORT TO BUILDING BOARD. University may report on the Claim to the Utah State Building Board.

7.8.15 UNIVERSITY'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 University to have any of University's issues, disputes or claims considered. University reserves all rights to pursue University'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 University, Contractor shall cooperate with such expert or panel process.

ARTICLE 8. PAYMENTS AND COMPLETION.

8.1 SCHEDULE OF VALUES. With the first Application for Payment, Contractor shall submit to the A/E and University 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 University. 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 University regarding the schedule of values including any suggested modifications. When approved, including any approved modifications, by University, 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 University. 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 University.

8.2.1.2 The Application for Payment shall be supported by such data substantiating Contractor's right to payment as University 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. University 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 University 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 University to establish University's title to such materials and equipment or otherwise protect University's interest, and shall include applicable insurance, storage, and transportation to the Work site for such materials and equipment stored off-site. University 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 University 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 University 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 UNIVERSITY. Notwithstanding anything to the contrary contained in the Contract Documents, University 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 University a Certificate for Payment, with a copy to the Contractor, for such amount as the A/E determines due or notify Contractor and University 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 University and University shall thereafter have twenty-one (21) days from the date of University'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 University 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 University 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 University, if in the A/E's judgment the representations to University 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 University 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 University. 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 University 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 University 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 UNIVERSITY NOT IN BREACH. University 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 University'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, University 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 University 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 University, 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 UNIVERSITY TO SUBCONTRACTOR. The A/E or University 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 University on account of portions of the Work done by such Subcontractor.

8.5.4 UNIVERSITY AND A/E NOT LIABLE. Neither University 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 University 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, University 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, University 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. University 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 University 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 University during such partial occupancy or use. The stage of progress of the Work shall be determined by written agreement between University and Contractor.

8.7.2 INSPECTION. Immediately prior to such partial occupancy or use, University, 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 University, 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. University 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 University:

8.8.2.1 An affidavit that payrolls, bills for material and equipment, and other indebtedness connected with the Work (less amounts withheld by University) 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 University;

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 University, 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 University. If a Subcontractor or Sub-subcontractor refuses to furnish a release or waiver required by University, University 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 University all money that University 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 University, 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, University 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 University in writing, the making of final payment shall constitute a waiver of claims by University as provided in Section 8.8.3 for that portion of that Work fully completed and accepted by University.

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 University in writing, University shall contract for such tests, inspections, and approvals with an independent entity, or with the appropriate public authority, and University 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 University, 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 University 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 University 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 University's expenses, including the cost of retesting for verification of compliance if necessary, until University 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 University 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 University or the A/E, including any inspector of each, does not appear, Contractor shall immediately notify University 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 UNIVERSITY 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 University 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 University 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 University. If such Work is not in accordance with the Contract Documents, Contractor shall pay such costs unless the condition was caused by University or a separate contractor in which event University 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 University and the A/E to determine if the Work is ready for a Substantial Completion inspection. If University 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 University 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 University 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 University, and upon concurrence of University, Contractor shall be assessed the costs of the inspection and punchlist review incurred by the A/E and University.

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 University 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 University. 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 University and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.

9.3.1.5 Except to the extent University 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 University and request a final inspection. University 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 University.

9.3.3 PUNCHLIST COMPLETION. As compensation to University for administrative costs incurred by University 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 University 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 University, 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 University to do so, unless University 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. University 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 University's right to pursue any available remedies against Contractor, including, but not limited to, University'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 University 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 University 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, University 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, University 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 University 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 University 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 University'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 University, Contractor shall furnish satisfactory evidence as to the type and quality of materials and equipment.

9.6 ACCEPTANCE OF NONCONFORMING WORK. If University prefers to accept Work that is not in accordance with the requirements of the Contract Documents, University 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 University 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 University 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 University 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 University 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 University 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 University, cancelled or allowed to lapse until thirty (30) days' prior written notice has been given to University.

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, University 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 University from any monies then due or thereafter to become due to the Contractor. If University 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 University 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 University'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 University 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"), University 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 University (or those for whom University 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 University or the Contractor, legally responsible for the negligence, breach of contractual duty or other fault that caused the losses or damages. If both University 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, University 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 University (or those for whom University 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), University 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. University 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 University as fiduciary. University 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 University 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 University 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 University and University'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 University 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 University. 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 University and the A/E incorporates these General Conditions by reference and includes additional design and contract administration responsibilities.

11.2 SUCCESSORS AND ASSIGNS. University 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 University, 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 University.

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 University, 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 University, 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 University.

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 University and Contractor, and University 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 University, 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 University has persistently failed to fulfill material obligations of University 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 University and A/E, and such condition giving cause for termination still not cured, terminate Contractor's Agreement and recover from University 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 UNIVERSITY FOR CAUSE.

12.2.1 IN GENERAL. University 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 University so approves in writing) after receipt of notice from University 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 UNIVERSITY'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 University, University may, without prejudice to other remedies available to University and in addition to enforcement of any other of University's rights, terminate the Contractor's Agreement, take possession of the Work site and all materials, finish the Work by whatever reasonable method University may deem expedient, and charge Contractor, or file a claim against Contractor's bankruptcy estate, for any additional costs incurred by University 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 University's costs exceed the amount of any payment(s) owed by University to Contractor subject to offset by University, University may bill Contractor for the difference, which Contractor shall pay within twenty-eight (28) days of receipt of University's invoice.

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

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 University, protect and preserve property in the possession of Contractor in which University has an interest.

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

12.2.5 UNIVERSITY PROTECTION IF LIENABLE. When the Work is lienable, University may withhold from amounts otherwise due Contractor for such Work such amount as University 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 University 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 University 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 University 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 UNIVERSITY.

12.3.1 IN GENERAL. The performance of Work under Contractor's Agreement may be terminated by University in accordance with this Section 12.3 in whole or in part, or from time to time, whenever University shall determine that such termination is in the best interest of University or any person or entity for whom University 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 University 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 University in the manner, at the times, and to the extent directed by University, all of the right, title, and interest of Contractor under the orders and subcontracts so terminated, in which case University 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 University, 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 University in the manner, at the times, and to the extent, if any, directed by University:

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 University;

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 University, 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 University; 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 University to Contractor under Contractor's Agreement or shall otherwise be credited against the Contract Price or paid in such other manner as University 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 University 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 University a PRE, in the form and with certification prescribed by University. 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 University 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 University 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, University shall pay to the Contractor the amounts determined by University 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 University 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 University 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 University, 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 University 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 University.

12.3.7 PARTIAL TERMINATION. If the termination is partial, Contractor may file with University 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. University 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 University, 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 University 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 University; 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 University 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 University at all reasonable times at the office of Contractor, but without charge to University, 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 University, photographs, or other authentic reproductions thereof.

12.3.10 SUSPENSION, DELAY OR INTERRUPTION OF WORK BY UNIVERSITY FOR CONVENIENCE. University 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 University may determine to be appropriate for the convenience of University.

12.4 UNIVERSITY'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; University, 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 University to stop the Work shall not give rise to a duty on the part of University to exercise this right for the benefit of Contractor or any other person or entity.

The University of Utah
FACILITIES MANAGEMENT

SUPPLEMENTAL
GENERAL CONDITIONS
FOR UNIVERSITY OF UTAH PROJECTS

September 30, 2011

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Revision Note: This document replaces the *Supplemental General Conditions for University of Utah Projects* dated May 2, 2011. The only change is a new paragraph 5.1 added to Article 5 "Request for Utility Shutdown."

Article 1 Basic Definitions

Except as otherwise described herein, definitions provided in the General Conditions apply to this document. The following definition is added to the General Conditions:

> **UNIVERSITY PROJECT MANAGER**. "University Project Manager" means the University of Utah Facilities Management person directly assigned to coordinate the University's interests and involvement in the Work. If the contractor's agreement is issued by the University of Utah, the "University Project Manager" is the "University's Representative" as defined in the General Conditions.

Article 2 Affirmative Action

The Contractor is encouraged to utilize the services of Small Business Enterprises, Disabled Veteran-Owned Business Enterprises, Minority-Owned Business Enterprises, Woman-Owned Business Enterprises, and Small Disadvantage Business Enterprises as subcontractors and/or suppliers for University projects. The Contractor may be required to survey and provide information on contracts and utilization of these services.

Article 3 Access to Communication Manholes

The University of Utah requires communications manholes on campus to be fitted with a secure access system. Authorization will be required before the Contractor may enter any communication manhole, whether secured or not. Authorization will be requested through the University Project Manager and permission will be given by University Information Technology - Network and Communication Services.

3.1 The Contractor must not proceed with any work in the manhole without first fully understanding the systems and equipment currently in place. Assistance in identifying communications systems and their functions in the manhole may be obtained from University Information Technology - Network and Communication Services at 801-581-8999.

3.2 Note that campus communication systems provide support to several critical functions at the University, including, but not limited to major research activities. An unintended shutdown may adversely affect several critical functions, including highly expensive research. Unintended shutdown of any communication service caused by the Contractor which results in any damage(s) will be assessed to and paid by the Contractor.

Article 4 Digging Permits

A Digging Permit shall be required for all underground digging on campus. The University and other non-University entities support an extensive network of underground utilities.

4.1 Contractors shall request digging permits through the University Project Manager.

4.2 Requests for a Digging Permit are available on-line or from the University Project Manager. Requests must be submitted at least five full University working days prior to the commencement of digging. The request should include a description of the intended work, and drawing(s) showing the intended work area and the contract limit lines.

4.3 This permit process does not automatically request Blue Stakes assistance. The Contractor must also contact Blue Stakes and other utility companies as applicable for assistance in locating non-University underground utilities.

4.4 The issued Digging Permit will identify University utilities known to exist within the affected area. After issuance of the permit, Facilities Management ("FM") will mark the location of existing University utilities at the site. Note that there is a risk that some underground utilities may not be documented in University records. All excavation should proceed with caution.

4.5 During excavation, the equipment operator shall have copies of the Digging Permit and Blue Stakes documentation in his/her immediate possession to guide the operator in utility avoidance and to document the University's approval of the work.

4.6 Additional assistance in locating existing University utilities is available from the University Surveyor at 801-585-5070.

4.7 Contractor shall provide the University Project Manager notice of not less than two working days prior to backfilling over utilities or other underground improvements. While the intent of this requirement is to allow the University to collect survey data, this does not relieve the Contractor of its obligation to maintain As-Built documentation required by Article 4.8 of the General Conditions.

Article 5 Request for Utility Shutdown

A Request for Utility Shutdown shall be submitted to the University Project Manager for each anticipated interruption of any existing utility service on campus. This includes, but is not limited to, any interruption to electric systems, communications; control systems, security, gas (natural, laboratory gasses, etc.), water (potable, non-potable, purified, etc.), steam systems, high-temperature water systems; sanitary sewer, storm sewer, etc. The Contractor is to discuss anticipated shut-down requirements with University Project Manager well in advance of the proposed shut-down.

5.1 Prior to beginning any work on a Utility Shutdown, the Contractor must meet with the University Project Manager and Plant Operations staff to define a hazard control plan that can include Lock Out Tag Out, Confined Space Entry, and NFPA 70 compliance. Refer to Article 24 in these Supplemental General Conditions for additional information. The Contractor must verify that all sources of hazardous energy for the affected system have been identified, properly controlled and/or isolated, and locked out prior to beginning any work. The Contractor and its subcontractors shall place their own locks on the shut down system as an added measure of protection for their employees.

5.2 Utility Shutdown Request forms are available on-line or they can be obtained from the University Project Manager.

5.3 Submit the request to the University Project Manager at least three (3) full University working days prior to the day of shut-down.

5.4 A longer lead time is required for interruptions affecting several campus departments, scientific experiment disruption, and similar complications. Shutdowns of this nature must be identified early and reviewed with the University Project Manager in order to determine notice requirements.

5.5 Each utility shut-down request is subject to approval by Campus Design & Construction, Plant Operations, and University departments which will be affected by the proposed loss of service.

5.6 If immediate shutdown is required to prevent damage to personnel or property, contact Plant Operations Dispatch at 801-581-7221.

Article 6 Drug Free Workplace

It is the policy of the University of Utah that "...the unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance on University property is prohibited." All contractors, subcontractors, and their employees, while under contract with the University must abide by the terms of the above policy. Violation may result in termination of the contract. The University will prosecute violators of this policy to the fullest extent possible.

Article 7 Hazardous Chemicals

The University of Utah shall inform contractors of hazardous chemicals their employees may be exposed to while working on University projects. Conversely, the Contractor shall inform the University of Utah of all hazardous chemicals the Contractor will bring on campus that University of Utah employees may be exposed to. This exchange of information shall occur through the University Project Manager.

Article 8 Interim Life Safety Measures

The Contractor must observe the following interim life safety measures during construction of the project. The University must approve any variance or exception in writing.

8.1 All exits will provide free and unobstructed egress.

8.2 Free and unobstructed access to emergency departments and for emergency forces will be maintained.

8.3 Fire alarm, detection, and suppression systems will not be impaired. In the event of disruption, alternative systems shall be provided which are satisfactory to the authority having jurisdiction.

8.4 Temporary construction partitions will be smoke tight and built of non-combustible or limited combustible materials that will not contribute to the development or spread of a fire.

8.5 The Contractor will provide appropriate additional fire fighting equipment (such as charged, current fire extinguishers) on the construction site.

8.6 Smoking is prohibited in or adjacent to construction areas.

8.7 The Contractor will develop and enforce storage, housekeeping, and egress removal practices that reduce the flammable and combustible fire load of the building to the lowest level necessary for daily operation.

8.8 When structural or compartmentation features of fire safety are compromised, the Contractor will notify the A/E and University Project Manager so that the University can develop alternate fire safety procedures.

Article 9 Keys

Should the Contractor require key(s), (as determined by the University Project Manager) for access to the Project Site, the University Project Manager shall arrange to obtain such key(s) for the Contractor.

9.1 At the completion of the Project and before final payment is approved, the Contractor shall return University key(s) to the University Project Manager. Should he/she be unable to do so because of loss, theft, or for any reason, the cost of replacement key(s) and/or re-keying of any locks deemed necessary shall be deducted from the Contractor's final payment. Loss or theft of keys is to be reported to the University Project Manager immediately.

Article 10 No Smoking Area

In order to comply with the Utah State Clean Air Act which prohibits smoking in public buildings, a strict no smoking policy shall be enforced at any job site located within the confines of any University of Utah building or within 25 feet of any building opening or entrance. This policy will apply to all contractors, their employees and subcontractors.

Article 11 Operating and Maintenance Manuals / Warranties and Guarantees

11.1 All information is to be organized by discipline (architectural, mechanical, electrical, etc.).

11.2 Security Systems O&M Manuals and Warranties/Guarantees

a. The Security Contractor shall submit security systems O&M and warranty/guaranty documents separately.

b. These documents must be delivered directly to the UCard main office by the installing Security Contractor. No other entity will receive a copy of security system documentation.

11.3 Warranties and Guarantees

a. Submit two sets of paper originals bound in a binder for the University (plus sets required by DFCM for their projects)

b. Submit two CDs of the same information prepared electronically in a self executable searchable PDF format for the University (plus sets required by DFCM for their projects).

c. Hard copies and electronic submittals are to be clearly identified on the front cover and label with the title “Warranties and Guarantees”, University building number, the project name, University project number, and the Contractor’s business name.

11.4 Operating and Maintenance Manuals

a. Submit O&M manuals as a separate bound document in the same formats described above for warranties and guarantees (2 paper sets and 2 electronic copies of a self executable searchable PDF).

b. The following information shall appear on the front cover (both CD and hard copy):

"Operation and Maintenance Manual"

Building Number:
Project Name:
Volume Number:
University Project Number:

A/E Firm:
A/E Subconsultant(s):
Commissioning Agent:

Contractor:
Major Subcontractor(s):

c. Special equipment must include a material list, and special architectural items must include paint color identification (source and catalog number).

d. Include complete set(s) of building control diagrams, drawn as installed at the site with all sequences of operations included for all equipment. Equipment, devices and wiring shall be clearly identified with model, size, etc. These drawings are to be included in O&Ms as well as being framed behind glass and hung in the mechanical room along with a valve matrix showing valve type, service and location.

e. For each item of equipment, include approved submittals and provide data and instruction sheets marked to indicate the equipment/device serial number, the plan symbol found on the construction drawings, the model number, and all options ordered.

f. Additionally, the following information is to be included:

(1) A table of contents.

(2) A complete parts list(s) and source of supply for each piece of equipment, including contact information (addresses and phone numbers).

(3) The balance report, where applicable.

(4) Performance curves and capacity data.

(5) Wiring diagrams.

Article 12 Parking Permits

Every vehicle will require a permit to park on the University of Utah campus. The Contractor is responsible for all costs of required parking permits. Contractor permits are available at 1901 E. South Campus Drive, Room #101 (the north-west corner of the Annex Building just east of the Jon M. Huntsman Center). The sale of parking permits to Contractors is subject to any limitations or other constraints identified in the bidding documents and by University of Utah Commuter Services.

Article 13 Parking on University Sidewalks

Parking or driving on campus sidewalks is not allowed unless prior authorization is received and a hang-tag permit is clearly visible in the vehicle. Authorization must be obtained through the University Project Manager. The hang-tag shall be placed on the vehicle's dashboard or interior mirror, fully visible through the windshield at all times. Not all sidewalks are vehicle accessible. For more information see http://www.facilities.utah.edu/sidewalkpermits/ .

Article 14 Sexual Harassment

Sexual harassment of any kind is taken very seriously at the University. Contractors will be held responsible for the actions of their employees and subcontractors while working on University projects. Any contractor, subcontractor, or employee thereof participating in verbal or other sexual intimidation of any kind toward any other individual or group (e.g., making "catcalls") shall be held in violation of Federal Law, Title VII, Section 703 (sexual harassment) and will be prosecuted to the fullest extent possible. University sanctions of convicted violators may include, but not be limited to, termination of Contract.

Article 15 Site Lighting

New and existing site lighting along walkways and around the perimeter of the construction site shall be operational for all hours of darkness during extent of construction. Upon notification of lighting failure, the Contractor shall respond and initiate repair of the failed system within four hours of notification. If the response time is exceeds four hours, the University reserves the right to repair the system and the Contractor will then be responsible for the repair costs.

Article 16 Tax Exemption

Do not include Utah State Sales and Use Tax on materials purchased for the Work, and do not include this tax on materials for proposed changes or invoices. The University of Utah is exempt from Federal Excise Taxes and Utah Sales and Use Taxes. The Contractor is responsible for complying with all Utah State Sales and Use Tax exemption requirements. The Contractor is responsible for payment of all Utah State Sales and Use Tax obligations that arise from the Contractor's failure to comply with exemption requirements.

The Utah State Tax Commission Exemption Certificate (Number N21318)
is provided on the following page.

TAX EXEMPTION CERTIFICATE

Utah State Tax Commission

Exemption Certificate

(Sales, Use, Tourism and Motor Vehicle Rental Tax)

TC-721
Rev. 1/09

Name of business or institution claiming exemption (purchaser) University of Utah		Telephone Number 801-581-7241	
Street Address 1901 E South Campus Dr Rm 151	City Salt Lake City	State UT	ZIP Code 84112
Authorized Signature	Name (please print) James T. Parker	Title Director of Procurement & Supply Mgt.	
Name of Seller or Supplier:		Date	

The person signing this certificate MUST check the applicable box showing the basis for which the exemption is being claimed. Questions should be directed (preferably in writing) to Taxpayer Services, Utah State Tax Commission, 210 N 1950 W, Salt Lake City, UT 84134. Telephone (801) 297-2200, or toll free 1-800-662-4335.

DO NOT SEND THIS CERTIFICATE TO THE TAX COMMISSION
Keep it with your records in case of an audit.

☒ **CONSTRUCTION MATERIALS PURCHASED FOR RELIGIOUS AND CHARITABLE ORGANIZATIONS**

I certify the construction materials purchased are on behalf of a religious or charitable organization. I further certify the purchased construction materials will be installed or converted into real property owned by the religious or charitable organization.

Name of religious or charitable organization:
UNIVERSITY OF UTAH

Sales Tax Exemption No. N21318

Name of project: _____

To be valid this certificate must be filled in completely, including a check mark in the proper box.

A sales tax license number is required only where indicated.

Please sign, date and, if applicable, include your license or exemption number.

NOTE TO SELLER: Keep this certificate on file since it must be available for audit review.

NOTE TO PURCHASER: Keep a copy of this certificate for your records. You must notify the seller of cancellation, modification, or limitation of the exemption you have claimed.

If you need an accommodation under the Americans with Disabilities Act, contact the Tax Commission at (801) 297-3811 or TDD (801) 297-2020. Please allow three working days for a response.

DO NOT SEND THIS CERTIFICATE TO THE TAX COMMISSION
Keep it with your records in case of an audit.

Article 17 Water Use on Campus

Fire hydrants on campus may only be used with permission. If water trucks or tanks must be filled outside the construction area, the water station between Buildings 306 and 309 may be used.

Article 18 Storm Water Pollution Prevention (SWPPP)

In addition to complying with the SWPPP requirements provided for in the Instruction to Bidders, the Contractor shall comply with the following. The University must approve any variance or exception in writing.

18.1 The Contractor must employ the following storm water pollution prevention measures during construction of the project.

a. Perimeter control, a system of sediments control best management practices (BMPs) that act as barriers to retain sediment on the construction site.

b. Construction entrance/exit stabilization for all entrances/exits used by the project, no matter how short the duration. Sediment tracking onto University roads, parking lots, sidewalks, and other paved surfaces is prohibited. If tracking occurs, the Contractor must clean the affected area before the end of the workday.

c. Temporary earth stabilization until final stabilization has been achieved.

d. Protect all storm drain inlets/catch basins that could receive storm water from the project until final stabilization of the site has been achieved.

e. If concrete work is part of the project, a concrete washout area must be provided. The area must be lined or a sealed container may be used.

18.2 The Contractor's SWPPP must be reviewed and approved by the University's Department of Environmental Health and Safety (EHS) prior to submitting the application (NOI) online, and the Contractor must have the permit before beginning construction. The University Project Manager will assist in submitting the Contractor's SWPPP to EHS.

18.3 The Contractor shall assume full responsibility for any SWPPP drafted by others and adopted by the Contractor for use at the construction site. The Contractor shall finalize and file the SWPPP grading, sediment and erosion control plan and pay permit fees. The Contractor shall make any needed modifications to the SWPPP to fit the existing site conditions prior to beginning construction.

18.4 In addition to other requirements, the Contractor shall:

a. Inspect the construction site to verify the SWPPP plan every two weeks and after significant rainfall, and keep a record of each inspection at the construction site,

b. Remedy deficient management practices, controls and control structures; and,

c. Modify the SWPPP as site conditions change (i.e., as demolition and construction phases progress).

Article 19 Vehicle Idling Policy

In an effort to reduce vehicle emissions and fuel use at the University of Utah, the Contractor shall adhere to this idling policy for all vehicles and equipment operating on campus.

19.1 For the purposes of this policy, idling means an engine is running while the vehicle it serves is stationary, or the equipment it operates is not performing work.

19.2 Contractor vehicles and equipment are prohibited from idling for periods longer than 60 seconds except under the following conditions:

a. Where idling is necessary to power auxiliary equipment such as lifts, hoists, computers or safety lighting (auxiliary equipment does not include the vehicle's air conditioner, heater or defrost for wintertime vehicle warm up),

b. Where idling is necessary for testing, maintenance, repair or diagnostic purposes,

c. Where idling is necessary to maintain factory installed emissions equipment on diesel equipment,

d. Where a vehicle is stopped at a traffic control signal; in heavy traffic at a TRAX line or railroad crossing; traveling through a construction zone; and / or,

e. Where turning off the motor could jeopardize the health and safety of the driver or passenger.

Article 20 Environmentally Preferable Products

Subject to limitations and the review and approval requirements stated in the General Conditions and other Contract Documents regarding substitutions, substitution requests and the use of specified materials or products, the Contractor, where allowed, is encouraged to offer Energy Star certified products, EPEAT (Electronic Product Environmental Assessment Tool) recommended products, or products that meet FEMP (Federal Energy Management Program) standards for energy consumption. The University of Utah also encourages contractors to offer products or services, when allowed by Contract Documents, that have a lesser or reduced effect on human health and the environment when compared with competing products or services. Items considered may include raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, disposal, etc.

Article 21 Integrity of Fire Rated Partitions

For all construction work performed in patient care facilities, unless specifically shown on the drawings, neither the Contractor nor any Subcontractor shall allow holes, cuts, or any other type of penetration in any floor slab, partition above the ceiling, or any otherwise concealed partition, without first notifying the University or the University's representative of every such occurrence. The purpose of this notification is to enable the University to verify that each such penetration is properly sealed according to the requirements of current UBC and NFPA codes (as part of the Work of the Contractor) if required by the

University. Prior to covering concealed locations, and prior to Substantial Completion, the Contractor shall be responsible to arrange an inspection with the University or University's representative where personal inspection will verify that each such penetration is properly sealed.

Article 22 Roof Access

Access to University roofs is limited to authorized personnel only. Roof safety is the responsibility of the Contractor and includes any individual working for or contracting with the Contractor. Safety issues include potential falling hazards and roof integrity protection. Any individual intending to access a University roof must first obtain permission follow the procedures described at the Plant Operations web site under "Roof Access."

Article 23 Utility Connections

Connections to certain campus utilities require specific tasks. The following utilities have specific connection task requirements:

23.1 Trace Wire. For all underground piping, a #10 THW copper wire must be installed alongside of the pipe to serve as a trace wire. The trace wire must be brought to the interior of valve boxes and manholes when applicable. At building penetrations, trace wire must be brought to the surface outside of the building and secured inside a single valve irrigation box with cover. Any terminations of trace wire not described above shall be secured inside a single valve irrigation box with cover. Terminations of the trace wire shall be noted on As-Built drawings.

23.2 Electrical Power-Up. The following requirements must be met prior to activating electrical power at new or remodeled buildings on campus. The Contractor's Work will be subject to inspection by the University's Electric Shop and power-up will not be allowed until the following requirements are met.

a. Manholes

(1) Switchgear in manholes shall be labeled to identify the building being served.

(2) Each new and existing high voltage cable shall be fire-taped and racked on manhole walls.

(3) Each new and existing high voltage cable shall be marked to indicate feeder number and feeder voltage.

(4) Each conduit leaving the manhole shall be marked to show the next manhole or building.

(5) Each manhole shall be labeled with a manhole number.

(6) All ground wires in the manhole and all terminations shall be properly grounded.

(7) Prior to power-up, each manhole shall be cleaned of all trash.

b. Above Ground High Voltage Switches and Transformers

(1) Switches and transformers shall be labeled to identify the voltage and building served.

(2) Properly ground all gear and terminations.

(3) Color code each feeder leaving the transformer per the voltage feeding the building. Colored tape shall be applied at all terminations, junction boxes and pull boxes. Conductors in sizes #6 and below shall be color coded with colored insulation. Power conductors shall be color coded as follows:

Conductor	**208v**	**480v**
phase A	black	brown
phase B	red	orange
phase C	blue	yellow
neutral	white	grey
ground	green	green

c. Main Distribution Panels

(1) Each distribution panel shall be grounded.

(2) Each feeder entering the panel from a transformer shall be color coded (as described in paragraph "b" above) to identify the voltage.

(3) Each distribution panel shall be labeled to identify the voltage.

d. Equipment Labeling

(1) Compliance with NFPA 70E 2009 130.3 C Equipment Labeling (including current updates) is required. All labels must be in place prior to connection to the University Electrical System.

23.3 High Temperature Water Connections. The following requirements must be met prior to activating high temperature water piping at new or remodeled buildings on campus. The Contractor will assist the University during system start-up.

a. Prior to requesting start-up assistance, the Contractor shall check all parts of the system for leaks, and repack valve stem glands that indicate a need for additional packing.

b No valve between existing and new HTW piping shall be opened until after all tests are approved, and internal cleaning operations are complete; then, system valves may be opened only with authorization and on-site-assistance from Campus Utility Services, the High Temperature Water Plant, and the University Project Manager.

c The HTW Plant personnel will provide on site management of the start-up process and direct the Contractor in valve positioning. The Contractor shall not activate any valve during start-up until directed to do so by the University.

d Additional requirements include:

(1) Shut-down and start-up will be accomplished by University personnel only. The Contractor shall follow "Request for Utility Shutdown" procedures, but allow additional lead time to allow adequate preparation time for University services.

(2) The Contractor shall boil out each HTW pipe system before connecting to a live HTW system. Water quality for start up must be 0 PPH and shall be verified by a University authorized water treatment specialist.

(3) Pressure test each pipeline at 800 lbs for 24 hours. If hydrostatic testing is not feasible, provide certification of a leak proof system through x-ray analysis.

(4) Before opening or cutting into any HTW pipe, the Contractor must verify 0 PSI in the line and receive approval from the HTW plant.

(5) All connections shall be welded and tested before start up. Threaded pipe connections will not be allowed.

(6) All pressure gauges, thermometers, valves, etc. shall be furnished and installed in the piping system prior to start-up.

(7) Pipe insulation will be installed in confined areas such as manhole vaults and any location where space limitations pose a risk of burn injury.

(8) Ladders shall be installed inside manhole vaults.

23.4 Natural Gas Main Connections. Natural gas piping shall be installed in accordance with State adopted code, DOT standards, Questar standards, and University of Utah standards.

a. Exterior buried gas lines shall follow Questar approved specifications for plastic pipe and shall be bedded in sand the entire length of the line. Exterior above ground gas lines 2-1/2" and larger shall be schedule 40 forged black steel butt welded fittings; or, for 2" and smaller shall be 150 lb malleable iron with screwed fittings. Steel pipe must have an approved protective coating.

(1) For buried plastic pipe, yellow warning tape shall be installed 2 feet above the gas line, in addition to an 18 gage copper wire along the entire length of the pipe.

(2) When a gas pipe is run though a wall, the pipe shall be run though protective sleeve and sealed to prevent water from entering the building.

(3) All outside above ground gas piping shall be painted with a protective gray paint.

b. All gas piping shall be tested at 3 PSI for 10 minutes with no drop. A half-pound increment gauge shall be used. Where the supply is over 2 pounds, the test shall be at 1 ½ times the maximum working pressure. All tests shall be witnessed by the University of Utah Plumbing Shop or its' designee.

23.5 Sanitary Sewer Connections. Sewer mains shall be installed in accordance with State adopted code, using procedures to keep dirt out of the sewer main. All installed piping shall be inspected by the University Plumbing Shop prior to backfill.

a. Buried sewer mains shall be bedded in sand and supported throughout its entire length. Under no circumstances will a pipe be supported with rocks.

b. Warning tape will be installed at 2 feet above the pipe when PVC pipe is installed.

c. Each new sewer main shall be air tested between manholes buy a certified testing company. If the air test fails, a camera shall be sent down the sewer main to inspect the line, and the damaged part of the main will be dug up and repaired.

d. All building laterals shall be tied in with a manhole, not a WYE.

23.6 Steam System Connections. An extension to any campus steam piping system will not be allowed until a stamped professionally engineered plan, including drawings and specifications, is approved by the University. Isolation shut-off valves and steam trap design is required.

a. Welded or threaded pipe connections are allowed on steam / condensate systems using only black steel pipe and fittings.

b. Verify the steam demand for each building system before adding any steam appliance.

c. Do not pipe condensate directly to sanitary sewer.

d. Verify proper steam connection points and condensate return connection points before completing the installation and connecting to the existing system.

23.7 Piping Tie-In to Existing Building Systems. All piping shall be insulated and labeled. Specific requirements for connections to existing building systems are:

a. Pressure Testing

(1) The Contractor shall apply a hydrostatic test to each piping system. Each system shall hold a minimum of 100 PSI of water or 1 ½ times the operating pressure, whichever is greater, for 30 minutes without any pressure drop on the gage.

b. Pipe Cleaning

(1) Piping (black iron, PVC, copper) shall be cleaned with West B802 Alkaline Clean, 25 gallons in every 1000 gallons of water. Circulate the mix 24 to 48 hours, flush with potable city water, then final fill the system with chemicals described hereinafter. The Contractor shall provide documentation and certify that the required procedure was followed.

c. Chemical Fill

(1) Each piping system to be connected to existing shall be filled with appropriate chemicals or antifreeze equal to the existing system before isolation valves are opened to the building system.

(2) Close loop systems shall have West C-404, 50 to 100 PPM, MO+6.

(3) Glycol systems shall have 30% minimum of either Jeffcool P150 or Dowfost.

(4) Open loop systems shall have West C-313-U at 200 PPM; and shall include sodium hypochlorite at 0.5 to 1.5 PPM.

d. Black iron piping shall be American made schedule 40 seamless (only).

e. Copper Piping

(1) Copper piping shall be type L with dielectric unions and sweat fittings.

(2) Gas welded piping shall be nitrogen purged while welding. All fittings will be wiped clean.

23.8 Storm Drainage Connections. Storm drainage piping shall be installed in accordance with State adopted code, and in a manner as to keep dirt out of the piping. All installed piping shall be inspected by the University Plumbing Shop and the University's inspector (Office of the Building Official) prior to backfill or concealment.

a. Exterior Piping

(1) Storm water from roofs, paved areas, yards, courtyards, etc. shall drain into a dedicated storm drainage system. Under no circumstance shall storm water be tied to a sanitary sewer line.

(2) Storm drainage piping shall be installed with a bedding material in the bottom of the trench. If PVC is used, 1 foot of sand on the bottom of the pipe, and 2 feet of sand over the top of the pipe will be required. Under no circumstance shall the pipe be resting on rocks.

(a) All storm drain laterals shall tie into a manhole or a collection box.

(b) A storm drain shall not reduce in size in the direction of flow.

(c) Buried storm drain piping 12 inches and smaller shall be tested by a certified testing company between manholes. If the test fails, a camera shall be sent down the line to determine the location of the bad section, it shall be dug up and repaired.

(d) Buried storm drain piping larger than 12 inches shall be inspected using a camera sent down the line to check joints for tightness. If a joint is not secure, it shall be dug up and repaired.

b. Interior piping:

(1) Storm drain piping inside buildings shall be tested using either water or air.

(a) If water is used, all openings shall be tightly sealed, except at the highest point, and then filled with water to the point of overflow. No part of the system shall be tested with less than 10 feet of head of water. The static pressure shall be held for 15 minutes.

(b) If air is used, 5 PSI shall be maintained for a minimum of 15 minutes will no loss on the gage.

23.9 Water Main Connections. Installation and disinfection of water mains shall be in accordance with State adopted code. Before connecting new water mains to an existing water main; the following must be done:

a. All water mains shall be kept clean during construction.

b. All fittings shall be installed with restraining glands and thrust blocks.

c. All water mains shall be swabbed and cleaned with a 1% hypochlorite disinfecting solution if dirt or trench water enters the pipe per State adopted code.

d. All water lines shall be capped at the end of the work day to protect piping from animal entry and dirt inside the pipe.

e. When C900 is used, it shall be bedded with sand one foot below the pipe and 2 feet above the pipe. Caution tape shall be installed at 2 feet above and all along the pipe.

f. All building supply lines shall be installed with shut off valves on all three sides of the tee.

g. To fill the water main with water, the Contractor must use an approved cross-connection control device. A hydrostatic pressure test will be required (200 PSI for 2 hours).

h All new water lines shall be chlorinated with a 50 PPM or higher and remain in the pipe for a 24 hour period. After the retention period, the heavily chlorinated water shall be flushed into a sanitary sewer only. Salt Lake City Sewer Department must be contacted to let them know that high chlorinated water is coming to them. Upon refilling the system with clean potable water, two bacteriological samples 24 hours apart shall be taken. After the second sample comes back satisfactory, the system can be connected to the University's water system. All work shall be inspected by the University of Utah's Plumbing Shop before being buried or concealed and prior to start-up.

23.10 Water Line Connections Inside Buildings. Water lines entering each building shall have parallel pressure reducing valves and parallel backflow prevention devices with appropriate isolation valves on each parallel path.

a. Backflow prevention devices shall be installed to separate potable water from industrial and/or non-potable water.

b. Installation shall be in accordance with State adopted code and will be inspected by the University Plumbing Shop and Building Inspector.

c. Each floor of the building shall have an isolation valve(s), accessible at the floor it serves.

d. Each laboratory room shall have an isolation valve(s), accessible in the lab it serves, in addition to shut-off valves at each fixture in the lab.

e. The Contractor shall test water piping at 2 times the operating pressure for 30 minutes. The test shall be in accordance with State adopted code.

f. The Contractor shall clean the water piping system by first flushing with clean potable water until dirty water is no longer observed at outlet points. The system shall be filled with clean water including 50 PPM chlorine and held in the system for 24 hours (or 200 PPM for 3 hours). The system shall then be flushed with clean potable water until chlorine is no longer present. The heavily chlorinated

water shall be flushed into a sanitary sewer only. Salt Lake City Sewer Department must be contacted to let them know that high chlorinated water is coming to them.

Article 24 Additional OSHA Requirements

In addition to any safety regulations or practices which may otherwise be required or prudent, the Contractor shall establish and implement safety programs that comply with the following OSHA General Industry regulations when working inside University buildings or on or around University utility systems:

24.1 CFR 1910.146, Permit Required Confined Space

24.2 CFR 1910.147; Control of Hazardous Energy (Lock Out Tag Out)

24.3 CFR 1910.335; Electrical Safeguards for Personal Protection

End of Supplemental General Conditions

SUPPLEMENTAL GENERAL CONDITIONS FOR HEALTH INSURANCE
Effective March 17, 2016

Article 1. Intent and Purpose.
Current law: House Bill 282, 2016 Utah Legislative Session. Legislative History: The 2009 Utah Legislature passed House Bill 331 entitled "Health Reform – Health Insurance Coverage in State Contracts" which law became effective July 1, 2009. This bill has been amended by HB20 of the 2010 Utah Legislative Session, HB 128 of the 2011 Utah Legislative Session as well as HB 282 of the 2016 Utah.

These laws require certain state entities, including DFCM, to require a contractor who contracts with the state entity to offer the contractor's employees qualified health insurance coverage as defined in Utah Code Annotated (UCA) 26-40-115, and in accordance with the commercially equivalent benchmark provided by the Department of Health, the CHIP commercial benchmark for FY 2016 and posted on the following URL: http://www.health.utah.gov/chip/PDF/2016Benchmark.pdf, in accordance with UCA 26-40-115(2), during the duration of the contract if the contract is over a certain amount, and if the contract is a construction and/or or design contract. The intent of the Articles of these Supplemental General Conditions is to provide the necessary provisions to the General Conditions as a result of such Bills. The purpose of this Supplemental General Conditions for Health Insurance is to comply with UCA 63A-5-205 as well as Utah Code Administrative Rule R23-23 which are both hereby incorporated by reference herein. In case of conflict between UCA 63A-5-205 and Rule R23-23, UCA 63A-5-205 shall control.

Article 2. Applicability of these Supplemental General Conditions.
This Supplemental General Conditions for Health Insurance only applies to those contracts as required by UCA 63A-5-205.

As stated in UCA 63A- 5-205:

(1) Except as provided in UCA 63A-5-205(4) below, UCA 63A-5- 205(3) applies to all design or construction contracts entered into by the Division or the Board on or after July 1, 2009, and
(a) applies to a prime contractor if the prime contract is in the amount of 2,000,000 or greater at the original execution of the contract; and
(b) applies to a subcontractor if the subcontract is in the amount of $1,000,000 or greater at the original execution of the contract.
(2) UCA 63A-5-205(3) does not apply if:
(a) the application of UCA 63A-5-205(3) jeopardizes the receipt of federal funds;
(b) the contract is a sole source contract;
(c) the contract is an emergency procurement;
(d) to a change order as defined in Section 63G-6a-103, or a modification to a contract, when the contract does not meet the threshold required by UCA 63A-5-205(3).

(3) A person who intentionally uses change order or contract modifications to circumvent the requirements of UCA 63A-5-205(3) is guilty of an infraction.

Article 3. Definitions.

The following definitions apply to this Supplemental General Conditions for Health Insurance:

3.1 “Contractor” means the person/entity under direct contract with the Division herein. If the direct contract includes a Design Professional, then the Design Professional is a "Contractor" for purposes of this Supplemental General Conditions for Health Insurance.

3.2 “Design Professional” means the Architect or Engineer, its Subconsultants or Subcontractors at any tier, or any of their agents, employees, including those employed directly or indirectly, or other persons or entities for whose acts the Design Professional or its Subconsultants/Subcontractors at any tier may be liable.

3.3 “Employee(s)” means an “employee.” “worker” or “operative” as defined in UCA 34A-2-104 who:

(i) works at least 30 hours per calendar week; and

(ii) meets employer eligibility waiting requirements for health care insurance which may not exceed the first day of the calendar month following 60 days from the date of hire.

3.4 "Health benefit plan" means the same as that term is defined in UCA 31A-1-301.

3.5 "Qualified health insurance coverage" means the same as that term is defined in UCA 26-40-115.

3.6 "Subcontractor" means the same as that term is defined in Section 63A-5-208.

3.7 "State" means the State of Utah.

3.8 “Director” includes an authorized designee of the Director.

Article 4. Health Insurance Certification.

4.1 A Contractor (including Design Professional) shall demonstrate compliance with UCA 63A-5-205 (6)(a) or (b) at the time of execution of each initial contract described in UCA 63A-5-205(3). The compliance is subject to an audit by DAS, DFCM or the Office of the Legislative Auditor General. A Contractor (including Design Professional) subject to UCA Section 63A-5-205(3) shall demonstrate to the director that the Contractor has and will maintain an offer of qualified health insurance coverage for the Contractor’s employees and employees’ dependents. Such Certification shall be on the form provided by DFCM.

4.2 If a subcontractor of the contractor is subject to Subsection (3) of UCA 63A-5-205, the contractor shall:

(a) place a requirement in the subcontract that the subcontractor shall obtain and maintain an offer of qualified health insurance coverage for the subcontractor's employees and the employees' dependents during the duration of the subcontract; and

(b) certify to the director that the subcontractor has and will maintain an offer of qualified health insurance coverage for the subcontractor's employees and the employees’ dependents during the duration of the prime contract.

4.3 The actuarially equivalent determination required for the qualified health insurance coverage is met by the Contractor if the Contractor provides the department or division with a written statement of actuarial equivalency, which is no more than one year old, regarding the contractor's offer of qualified health coverage from an actuary selected by the contractor or the contractor's insurer, or an underwriter who is responsible for developing the employer group's premium rates;

SUPPLEMENTAL GENERAL CONDITIONS REGARDING ILLEGAL IMMIGRATION

May 10, 2011

Article 1. Intent and Purpose. Senate Bill 81 modified by Senate Bill 39 – 2009. The 2009 Utah Legislature passed Senate Bills 81 and 39 regarding "**Illegal Immigration**" which laws became effective July 1, 2009 (hereinafter "SB81/39"). The 2011 Utah Legislature made further amendments that relate to this document in HB 116. These bills deal with provisions related to the immigration status of individuals within the state. The intent of Articles 1 through 3 of these Supplemental General Conditions is to provide the necessary provisions to the General Conditions as a result of such bills.

Article 2. Applicability. These "Supplemental General Conditions for Illegal Immigration" under SB 39 of the 2009 Utah General Legislative Session and HB 116 of the 2011 Utah General Legislative Session, only applies to Request for Proposals and includes sole sources that are part of Requests for Proposals. However, all entities under contract with DFCM as well as all others that are subject to applicable immigration laws, including their subcontractors/subconsultants, at any tier, shall comply with all applicable immigration laws. This document does not apply to procurements that are done by the Competitive Sealed Bidding process (often referred to as "low-bid"), the Multi-Step Process, direct awards, sole sources awards that are not part of Requests for Proposals, and emergency procurements. This document also does not apply to good faith contract modifications to contracts that existed prior to July 1, 2009.

There is a Program Start Date defined in said HB 116 of the 2011 Utah General Legislative Session. At such time that knowledge is obtained about when that Program Start Date is, DFCM will post an amendment to this "Supplemental General Conditions Regarding Illegal Immigration."

Article 3. E-Verify Clause. Certify registration and use of employment "Status Verification System".

3.1 Each offeror and each person signing on behalf of any offeror certifies as to its own entity, under penalty of perjury, that the named Contractor has registered and is participating in the Status Verification System to verify the work eligibility status of the Contractor's new employees that are employed in the State of Utah in accordance with 63G-12-302 as described in HB 116 of the 2011 Utah General Legislative Session. *(A copy of 63G-12-302 is provided at the end of this document for your convenience.)*

3.2 The Contractor shall require that the following provision be placed in each subcontract at every tier: "The subcontractor shall certify to the main (prime or general) contractor by affidavit that the subcontractor has verified through the Status Verification System the employment status of each

new employee of the respective subcontractor, all in accordance with Section 63G-11-103 and to comply with all applicable employee status verification laws. Such affidavit must be provided prior to the notice to proceed for the subcontractor to perform the work."

3.3 The State of Utah or DFCM will not consider a proposal for award, nor will it make any award where there has not been compliance with this Article.

3.4 Manually or electronically signing the Proposal is deemed the Contractor's certification of compliance with all provisions of this employment status verification certification required by all applicable status verification laws including UCA Section 63G-12-302 as described in HB 116 of the 2011 Utah General Legislative Session. *(A copy of 63G-12-302 is provided at the end of this document for your convenience.)*

Article 4. Indemnity

4.1 Contractor (includes, but is not limited to any Contractor, Design Professional, Designer or Consultant) shall protect, indemnify and hold harmless, the State of Utah, the DFCM and its officers, employees, agents, representatives and anyone that the State of Utah or the DFCM may be liable for, against any claim, damages or liability arising out of or resulting from violations of these Supplemental General Conditions Regarding Illegal Immigration whether violated by employees, agents, or contractors of the following:

4.1.1 Contractor;
4.1.2. Subcontractor at any tier; and/or
4.1.3 any entity or person for whom the Contractor or Subcontractor may be liable.

4.2 Notwithstanding 4.1 above, Design Professionals or Designers under direct contract with the DFCM shall only be required to indemnify the State of Utah or the DFCM for a liability claim that arises out of the design professional's services, unless the liability claim arises from the Design Professional's negligent act, wrongful act, error or omission, or other liability imposed by law except that the Design Professional shall be required to indemnify the State of Utah or the DFCM in regard to subcontractors or subconsultants at any tier that are under the direct or indirect control or responsibility of the Design Professional, and includes all independent contractors, agents, employees or anyone else for whom the Design Professional may be liable at any tier.

*** The following is provided for your convenience: Note: The definitions of "Public Employer," "Status Verification System," "Unauthorized Alien," and "Program Start Date" as well as other relevant definitions are located in Section 63G-12-102. Other provisions of Utah Code Title 63G, Chapter 12, should be read as well as all applicable immigration laws.)**

63G-12-302. Status verification system -- Registration and use -- Performance of services -- Unlawful practice.

(1) As used in this section:

(a) "Contract" means an agreement for the procurement of goods or services that is awarded through a request for proposals process with a public employer and includes a sole source contract.

(b) "Contractor" means a subcontractor, contract employee, staffing agency, or any contractor regardless of its tier.

(2) (a) Subject to Subsection (5), a public employer shall register with and use a Status Verification System to verify the federal employment authorization status of a new employee.

(b) This section shall be enforced without regard to race, religion, gender, ethnicity, or national origin.

(3) (a) Subject to Subsection (5), beginning July 1, 2009:

(i) a public employer may not enter into a contract for the physical performance of services within the state with a contractor unless the contractor registers and participates in the Status Verification System to verify the work eligibility status of the contractor's new employees that are employed in the state; and

(ii) a contractor shall register and participate in the Status Verification System in order to enter into a contract with a public employer.

(b) (i) For purposes of compliance with Subsection (3)(a), a contractor is individually responsible for verifying the employment status of only new employees who work under the contractor's supervision or direction and not those who work for another contractor or subcontractor, except as otherwise provided in Subsection (3)(b)(ii).

(ii) Each contractor or subcontractor who works under or for another contractor shall certify to the main contractor by affidavit that the contractor or subcontractor has verified through the Status Verification System the employment status of each new employee of the respective contractor or subcontractor.

(c) Subsection (3)(a) does not apply to a contract:

(i) entered into by the entities referred to in Subsection (3)(a) prior to July 1, 2009, even though the contract may involve the physical performance of services within the state on or after July 1, 2009; or

(ii) that involves underwriting, remarketing, broker-dealer activities, securities placement, investment advisory, financial advisory, or other financial or investment banking services.

(4) (a) It is unlawful for an employing entity in the state to discharge an employee working in Utah who is a United States citizen or permanent resident alien and replace the employee with, or have the employee's duties assumed by, an employee who:

(i) the employing entity knows, or reasonably should have known, is an unauthorized alien hired on or after July 1, 2009; and

(ii) is working in the state in a job category:

(A) that requires equal skill, effort, and responsibility; and

(B) which is performed under similar working conditions, as defined in 29 U.S.C., Sec. 206 (d)(1), as the job category held by the discharged employee.

(b) An employing entity, which on the date of a discharge in question referred to in Subsection (4)(a) is enrolled in and using the Status Verification System to verify the

employment eligibility of its employees in Utah who are hired on or after July 1, 2009, is exempt from liability, investigation, or lawsuit arising from an action under this section.

(c) A cause of action for a violation of this Subsection (4) arises exclusively from the provisions of this Subsection (4).

(5) On and after the program start date:

(a) a public employer, after hiring an employee, shall verify the employment eligibility of the new employee:

(i) through the status verification system if the individual does not hold a permit; and

(ii) through the u-verify program if the individual holds a permit; and

(b) a contractor is considered to be in compliance with this section if, after hiring an employee, the contractor verifies the employment eligibility of the new employee:

(i) through the status verification system if the individual does not hold a permit; and

(ii) through the u-verify program if the individual holds a permit.

Renumbered and Amended by Chapter 18, 2011 General Session

SUPPLEMENTAL GENERAL CONDITIONS FOR CONSTRUCTION AGREEMENTS

July 15, 2008

Article 1. Intent and Purpose: Senate Bill 220 – 2008.
The 2008 Utah Legislature passed Senate Bill 220 entitled "Cause of Action for Defective Construction" which law became effective May 5, 2008 (hereinafter "SB220"). The intent purpose of Article 1 through 3 of these Supplement General Conditions is to provide the necessary provisions to the General Conditions as a result of such Bill.

Article 2. "Entities under the Contractor" shall mean any and all agents, independent contractors, subcontractors, suppliers, manufacturers and providers at every tier under the General Contractor.

Article 3. General Provisions

3.1 Conditions. The General Conditions impose duties and performance obligations on the parties. This includes, but is not limited to, the provisions of Article 5.2.1 (regarding subcontractor's compliance with Contract Documents), Article 4.13 (indemnification which discusses acts, omissions, and negligence responsibility) and other provisions of the General Conditions which list many performance obligations of the General Contractor and those under the General Contractor.

3.2 Third Party Beneficiary. The State of Utah and DFCM shall be an intended third party beneficiary to all contracts entered into with Entities under the Contractor. Upon written request by DFCM, DFCM shall be entitled to obtain copies of all such contracts. The General Contractor shall be responsible for assuring that all such third party beneficiary agreements are in place and shall bear the responsibility for any lack of required language in any contracts with an Entity under the Contractor which does not contain this required provision.

3.3 "Economic Loss Rule." The "Economic Loss Rule" as it has been referred to in Utah law shall be deemed to be interpreted in accordance with prevailing Utah law.

3.4 Toxic Torts. "Defective Construction" for purposes of any limitation of any cause of action or right as contemplated by SB220 does not, under these Supplemental General Conditions and for purposes of any Entities under the Contractor, include the use or installing of a defective or inherently dangerous, hazardous or toxic product, substance, or material. The State has third party beneficiary rights and other rights allowed by law to pursue a direct cause of action against the manufacturer and/or distributor of such defective or inherently dangerous, hazardous or toxic product, substance or material, except that the General Contractor and other subcontractors, exclusive of manufacturers and distributors, under the General Contractor shall not be responsible to the State of Utah for said "product, substance or material" unless the General Contractor or such subcontractor knew or should reasonably have known that the product, substance or material was defective or inherently dangerous, hazardous or toxic at the time it was provided or installed on the Project.

3.5 Subsection 3 of SB 220. For purposes of Subsection (3) of SB 220, the phrase "property damage" shall be deemed to refer to damage to "other property" meaning property that is other than the exact specific construction defect itself.

3.6 "Failure of the Construction to Function as Designed." The language "failure to function as designed" as used in SB 220 shall not be deemed to refer to the failure of the construction to be constructed in accordance with the Contract Documents.

3.7 Independent Duty. The State of Utah and DFCM maintain the right to pursue a cause of action against the General Contractor and directly against any Entities under the Contractor, for violation of any independent duty owed to the State of Utah or DFCM.

3.8 Not create Contract Right by Entity under the Contractor with State of Utah or DFCM. These Supplemental General Conditions shall not be construed in any manner which would create a contract between the State of Utah/DFCM and any Entity under the Contractor, except for the Third Party Beneficiary rights of the State of Utah/DFCM provided herein. Any pursuit of a claim by an Entity under the Contractor, including payment claims, shall be maintained either against the payment bond or the upper tier Contractor in accordance with Utah law.

Article 4. Warranties and Obligations

Every Entity under the Contractor has an obligation to comply with the requirements of this Contract, including the indemnification of the Owner for negligent or intentional construction defects and to provide materials and construction that meets all express or implied warranties under the Uniform Commercial Code, including fitness for a particular purpose, merchantability, workmanlike construction (work completed in a skillful manner and is non-defective) and habitability, and is performed with the reasonable care to protect persons and property. In regard to toxic, hazardous materials and other matters of construction where applicable statutory and case law allows, strict liability shall apply.

SUPPLEMENTAL GENERAL CONDITIONS FOR DESIGN AGREEMENTS

July 15, 2008

Article 1. Intent and Purpose: Senate Bill 220 – 2008.
The 2008 Utah Legislature passed Senate Bill 220 entitled "Cause of Action for Defective Construction" which law became effective May 5, 2008 (hereinafter "SB220"). The intent purpose of these Supplement General Conditions is to provide the necessary provisions to the General Conditions as a result of such Bill.

Article 2. "Entities under the Designer" shall mean any and all agents, independent contractors, consultants, subconsultants, subcontractors, suppliers, manufacturers and providers at every tier under the Designer.

Article 3. General Provisions

3.1 Design Agreement. The Design Agreement for the subject Project imposes duties and performance obligations on the parties. This includes, but is not limited to, the standard of care provisions provided in said Design Agreement.

3.2 Third Party Beneficiary. The State of Utah and DFCM shall be a third party beneficiary to all contracts entered into with Entities under the Designer. Upon written request by DFCM, DFCM shall be entitled to obtain copies of all such contracts. The Designer shall be responsible for assuring that all such third party beneficiary agreements are in place and shall bear the responsibility for any lack of required language in any contracts with an Entity under the Designer which does not contain this required provision.

3.3. "Economic Loss Rule." The "Economic Loss Rule" as it has been referred to in Utah law shall be deemed to be interpreted in accordance with prevailing Utah law.

3.4 Toxic Torts. "Defective Construction" for purposes of any limitation of any cause of action or right as contemplated by SB220 does not, under these Supplemental General Conditions and for purposes of any Entities under the Designer, include the use or installing of a defective or inherently dangerous,

hazardous or toxic product, substance, or material. The State has third party beneficiary rights and other rights allowed by law to pursue a direct cause of action against the manufacturer and/or distributor of such defective or inherently dangerous, hazardous or toxic product, substance or material, except that the Designer and other consultants/subconsultants under the Designer, exclusive of manufacturers and distributors, shall not be responsible to the State of Utah for said "product, substance or material" unless the Designer or such consultants/subconsultants knew or should reasonably have known that the product, substance or material was defective or inherently dangerous, hazardous or toxic at the time it was made a part of the Contract Documents by the Designer.

3.5 Subsection 3 of SB 220. For purposes of Subsection (3) of SB 220, the phrase "property damage" shall be deemed to refer to damage to "other property" meaning property that is other than the exact specific construction defect itself.

3.6 "Failure of the Construction to Function as Designed." The language "failure to function as designed" as used in SB 220 shall not be deemed to refer to the failure of the construction to be constructed in accordance with the Contract Documents.

3.7 Independent Duty. The State of Utah and DFCM maintain the right to pursue a cause of action against the Designer and directly against any Entities under the Designer, for violation of any independent duty owed to the State of Utah or DFCM.

3.8 Not create Contract Right by Entity under the Designer with State of Utah or DFCM. These Supplemental General Conditions shall not be construed in any manner which would create a contract between the State of Utah/DFCM and any Entity under the Designer, except for the Third Party Beneficiary rights of the State of Utah/DFCM provided herein. Any pursuit of a claim by an Entity under the Designer, including payment claims, shall be maintained against the upper tier entity in accordance with Utah law

SUPPLEMENTAL GENERAL CONDITIONS FOR DRUG AND ALCOHOL TESTING DESIGN AND/OR CONSTRUCTION CONTRACTS

July 1, 2010

1. These Supplemental General Conditions shall only apply to design or construction contracts in compliance with UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7. (Note: the Administrative Rule is anticipated to have an effective date in early July, 2010 and will upon its being effective apply to those design and construction contracts issued on or after July 1, 2010, and the Statute itself is effective on July 1, 2010.) All applicable provisions of UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7 are incorporated herein by reference as if fully set forth herein. The provisions below provide some, but not all of the provisions of said statute and administrative rule. The absence of the recitation of a provision of UCA Section 63G-6-604 or Utah Administrative Code Rule R23-7 below, shall not lesson its importance. Contractors and Designers are encouraged to read the complete UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7 in order to assure compliance with all the applicable provisions.

2. Definitions. For the purpose of these Supplemental General Conditions, the definitions in UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7 shall apply. For convenience, the following definitions are provided below:

a. **"Contractor" for purposes of these Supplemental General Conditions includes the Prime Contractor, a Designer (Architect/Engineer), and any of their subcontractors, consultants or subconsultants at any tier involved in design and/or construction. "Contractor" for purposes of these Supplemental General Conditions does not include a supplier who provide only materials, equipment or supplies to a Contractor, Designer or any of their subcontractors, consultants or subconsultants at any tier.**

b. "Covered Individual" means an individual who: (i) on behalf of the Contractor provides services directly related to design or construction under the contract; and (ii) is in a safety sensitive position, including a design position that has responsibilities that directly affect the safety of an improvement to real property that is the subject of a state construction contract

3. Contractor shall have a drug and alcohol testing policy in accordance with UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7 during the period of the contract that applies to the "Covered Individuals" hired by the Contractor. Contractor shall post in one or more conspicuous places notice

to "Covered Individuals" hired by the Contractor that the Contractor has the drug and alcohol testing policy described in UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7-4(1)(a)(i). Said "Covered Individuals" shall be subject to random drug and alcohol testing under said policy if at any time during the period of the contract there are ten (10) or more "Covered Individuals" hired by the Contractor.

4. Contractor hereby certifies the following:

a. By executing this Contract, that the Contractor, including all entities included in the definition of Contractor in paragraph 2.a. above, shall comply with all provisions of Utah Administrative Code Rule R23-7 as well as UCA 63G-6-604, including having and maintaining a drug and alcohol testing policy, the posting and random testing requirements during the period of the contract that applies to Covered Individuals hired by the Contractor, including all entities included in the definition of Contractor in paragraph 2.a. above;

b. That the Contractor, including all entities included in the definition of Contractor in paragraph 2.a. above, shall have these requirements placed in all subcontracts for design or construction at any tier, in order that all such subcontractors, consultants and subconsultants at any tier have notice of these requirements and understand the need for compliance with these requirements;

c. That the subcontractors, consultants and subconsultants at any tier referred to in paragraph 4.b. above shall comply with the same requirements as the Contractor for having and maintaining a drug and alcohol testing policy, the posting and random testing requirements during the period of their contract;

d. That the Contractor, or any entity included in the definition of Contractor in paragraph 2.a. above may be suspended or debarred in accordance with the Utah Procurement Code for failure to comply as provided in UCA Section 63G-6-604(3)(a) and Utah Administrative Code Rule R23-7-4(3)(b); and

e. That the prime contactor or prime designer shall on a semi-annual basis throughout the term of this Contract, report to the Division in writing, information that indicates compliance with the provisions of UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7.

5. Reasonable notice and an opportunity to cure any violation of UCA 63G-6-604 shall be provided to the Contractor before any suspension or debarment may be undertaken by the Division against the Contractor in light of the circumstances of the Contract or the violation. The greater the risk to person(s) or property as a result of noncompliance, the shorter this notice and opportunity to cure shall be, including the possibility that the notice may provide for immediate compliance if necessary to protect person(s) or property.

6. If a Contractor meets the requirements of UCA Section 63G-6-604 and Utah Administrative Code Rule R23-7, said statute and rule may not be construed to restrict the Contractor's ability to impose or implement an otherwise lawful provision as part of a drug and alcohol testing policy.

SECTION 01 1000 - 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. Contractor's use of site and premises.
4. Coordination with occupants.
5. Work restrictions.

B. Related Requirements:

1. Section 01 5000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

A. Project Identification: University of Utah University of Utah, Building 303 – Phase# 4

1. University of Utah Project Number: 22508.
2. FFKR Project Number: 18136.
3. Project Location: University of Utah, Building 303 Salt Lake City, UT 84123.

B. Owner: State of Utah; University of Utah.

1. Owner's Representative:

a. University of Utah: Steve Laraway, David Quinlivan, Rich Wilcox, Scott Hartwig.

C. Architect: FFKR Architects, 730 Pacific Avenue, Salt Lake City, Utah 84104, (801) 521-6186.

1. Contact: Jackson Ferguson / Ying Peng.

D. General Contractor/Construction Manager:

1. Construction Manager for this Project is Project's constructor. The terms "Construction Manager" and "Contractor" are synonymous.

E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 01 3100 "Project Management and Coordination." for requirements for using web-based Project software.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. Work of Project: Phase #2 of seismic upgrade and other improvements to existing Building 303 and surrounding areas on the University of Utah Campus. Project will be issued in 6 Phases as follows:

1. Phase #1: Scope of Work as indicated in Contract Documents for Phase #1, including, but not limited to, the following site work:

   a. Demolition of existing curbs and construction of new curbs as required to align curbs.
   b. Demolition of existing Northwest brine tank and construction of new brine tank.
   c. Removal of indicated electrical items and construction of new electrical Work.
   d. Demolition of existing Northeast gas line and chill water line and construction of new gas line and chill water line.
   e. Demolition of indicated dumpster enclosure.
   f. Capping of indicated water lines inside building.
   g. Coordination of moving of MCC #5 with Gen 5/9 project.

2. Phase #2: Scope of Work as indicated in Contract Documents for Phase #2, including, but not limited to, the following work:

   a. Demolition of existing screen wall on roof.
   b. Demolition of existing roof assembly.
   c. Demolition of stairs by Gen 4.
   d. Removal of existing roof exhaust fans, oil cooler, condensate tank, and hoppers.
   e. Construction of new oil cooler.
   f. Construction of new interior diaphragm.
   g. Construction of new roof assembly, including bracing, decking, roof system, curbs, and parapets and roof drains.
   h. Construction of new condensate tank, roof top exhaust fans, and water tank for research project.

1. Phase #3: Scope of Work as indicated in Contract Documents for Phase #3, including, but not limited to, the following work:

   a. Demolition of existing asphalt indicated.
   b. Construction at buttresses foundations, including micropiles, underpinnings, concrete capping, internal links and buttress structural links.

1. Phase #4: Scope of Work as indicated in Contract Documents for Phase #4, including, but not limited to, the following work:

a. Selective demolition of indicated portion of building, including existing control room east of Gridline A, indicated office space, and indicated existing west brick wall.
b. Construction of new office wing.
c. Construction of new west exterior wall assembly and insulated metal panel system.
d. Construction of new southwest buttress exterior walls.
e. Construction of new fire sprinkler system.

1. Phase #5: Scope of Work as indicated in Contract Documents for Phase #5 including, but not limited to, the following work:

a. Selective demolition of brick walls on south and east sides of building.
b. Construction of new east and south exterior wall assemblies, including new structural framing, air and water barriers, and insulated metal panel systems.
c. Construction of new northeast, southeast and northwest exterior buttress walls.

2. Phase #6: Scope of Work completing project as indicated in Contract Documents for Phase #6, including, but not limited to, the following work:

a. Selective demolition of brick walls on north side of building.
b. Construction of new north exterior wall assemblies, including new structural framing, air and water barriers, and insulated metal panel systems.
c. Construction of new equipment bracing, pipe bracing, and pipe insulation.
d. Repairing existing asphalt and construction of new asphalt paving.
e. Construction of new make-up air unit on roof for both supply and exhaust air.
f. Construction of new penthouse and access stair from Fan level to roof,
g. Construction of new dumpster enclosure.

B. Type of Contract: Single prime contract.

1.5 CONTRACTOR'S USE OF SITE AND PREMISES

A. See University of Utah U Facilities; General Conditions; Article 4 Contractor; 4.9 Use of Site; 4.9.1 in General.

B. See University of Utah U Facilities; General Conditions; Article 2 The University; 2.2 Construction by the University or by Separate Contractors; 2.2.1 University’s Right to Perform Construction and to Award Separate Contracts.

C. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

D. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

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.

E. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

F. 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.

1.6 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy Project site and existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.7 WORK RESTRICTIONS

A. See University of Utah U Facilities; General Conditions; Article 4 Contractor; 4.9 Use of Site; 4.9.2 Access to Neighboring Properties.

B. Employee Identification: All Contractor personnel will be required to obtain University of Utah identification badges.

C. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

E. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

F. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances within the existing building is not permitted.

G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 1000

SECTION 01 2300 - ALTERNATES

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 alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Add Southwest buttress enclosure.

1. Base Bid: All elements north of Grid 6 and below elevation 4760'-0, as indicated on Drawings.

a. If alternate is not approved, apply details D5/AE-506 and A6/AE-501, where applicable.

2. Alternate: Add Southwest buttress enclosure as indicated on Drawings.

END OF SECTION 01 2300

SECTION 01 2500 - 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 Requirements:

1. Section 01 6000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

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 in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Proposed Products List and Substitution Requests:

1. Intent:

a. To fully identify, prior to beginning the Work, the products Contractor intends to provide, and substitutions the Contractor requests.
b. To facilitate timely submittal processing by avoiding rejection of unacceptable products and unspecified products later during construction.

2. Proposed Products List:

a. Within 14 calendar days after date of receipt of notice to proceed and before submitting any Product Submittals, submit for approval the list of the products

proposed for installation. Include the name of the manufacturer for each product and, where applicable, the name of Subcontractor.

b. The list shall be tabulated by and be complete for each Specification Section.

c. For each product listed, clearly indicate: a) As Specified, or b) Not As Specified. For each product designated Not As Specified, clearly indicate: c) Comparable Product, or d) Proposed Substitution.

B. Substitution Requests Accompanying the Proposed Products List:

1. A request for substitution will be considered, subject to the following requirements:

a. Include with the proposed products list a completed substitution request form for each proposed substitution anticipated for the Project. Check the box indicating the request is submitted with the proposed products list.

b. Submit each proposed substitution using a separate copy of the substitution request form. Use substitution request form included in the Project Manual, or request form from the Architect. See Section 01 2510 Substitution Request Form. Submit in number of copies specified for proposed product list.

c. The substitution request is submitted at the time the proposed products list is submitted. A request submitted after the time set for submittal of the proposed products list is subject to automatic rejection.

d. Include with the request complete data on the proposed substitution. Such data shall include:

1) Product Data highlighted to show applicability to the proposed substitution and project conditions.

2) Performance and test data.

3) References, and samples, where applicable.

4) An itemized comparison of the proposed substitution with the product features specified in the Contract Documents, including data relating to design and artistic effect, where applicable.

e. Include copies of the pertinent Contract Documents, clearly marked and highlighted to show changes necessary to accommodate the proposed substitution.

f. If the proposed substitution is due to unavailability of a specified product, a written statement shall accompany it, written by the supplier of the specified product, confirming lack of availability.

g. By submitting the substitution request, Contractor affirms that: 1) the proposed substitution conforms to the required dimensions and meets or exceeds the standards of required function, appearance, and quality set by the specified product: and 2) the burden of proof rests with the Contractor.

h. By submitting a substitution request, Contractor agrees to absorb all costs resulting from acceptance of the proposed substitution, including both known and subsequently discovered revisions to other construction needed to accommodate the substitution, and other expected and unforeseen costs, such as delays, code approval-related expenses, and additional architectural services.

C. Substitution Requests After Proposed Products List:

1. Use no product in the Work that is not named in the Contract Documents, or not listed in the Proposed Products List, or not approved as a substitute or comparable product.

Products specified solely by reference standard or performance requirements do not require naming.

2. During construction of the Work, products not listed on the accepted Proposed Products List shall not be used without receipt of an approved substitution request for a listed product. A substitution request will be considered under one of the following conditions:

    a. The product listed on the accepted Proposed Product List becomes unavailable. Include with the substitution request a letter from the listed manufacturer, on the manufacturer's letterhead, verifying that the product is no longer available.
    b. Conditions uncovered at the Site render the listed product inappropriate, or an undesirable choice for the conditions uncovered. Include with the substitution request a full description of the uncovered conditions and why the requested substitution is preferable to the listed product.

3. Make each substitution request on the specified substitution request form. Fully execute form in accordance with the provisions of Article, Proposed Products List and Accompanying Substitution Requests, except for provisions requiring submittal concurrent with proposed products list. Check the box indicating the Contractor's request is being submitted separate from and after submittal of the proposed products list

D. A request for substitution forwarded by the Contractor means that Contractor:

1. Has investigated the proposed substitution.
2. Has determined that the substitution is equal to or superior in quality and serviceability (performance) to the product specified in the Contract Documents.
3. Will provide the same guarantee for the substitution that is required for the product specified in the Contract Documents.
4. Waives all claims for additional costs that subsequently become apparent as a result of the substitution.
5. Will coordinate the installation of the accepted substitution into the Work, and will make such changes in the Work of the various trades as may be required to provide a completed condition.

E. A request for a substitution will not be considered if:

1. The substitution is merely indicated or implied on the Shop Drawing or Product Data submittal without the specified formal request and documented proof of conformance. Submittal approvals for items not meeting specifications are not valid. Completed construction related to such items is subject to rejection.
2. Implementation requires a major revision of the Contract Documents in order to accommodate the substitution.
3. The substitution request is substantially incomplete.

F. Architect's Review of Proposed Products List and Substitution Requests:

1. The Architect will review properly submitted proposed products list and accompanying substitution requests.
2. The Architect will evaluate each substitution request and inform Contractor in writing whether the proposed substitution is accepted, accepted as noted, or not accepted.

a. Substitution requests that do not conform to requirements, including submittal timing, are subject to return without review.
b. A substitution will not be considered accepted by the Owner until it has been documented by Change Order.

3. The Architect's decision as to conformance and acceptability will be consistent with the intent of the Contract Documents.
4. In the absence of written acceptance of a substitution request, proposed substitutions shall be understood as not accepted.
5. The Architect will endeavor to evaluate the substitution request in a reasonable period of time. With the request, the Contractor shall inform the Architect of the deadline for final decision on the request. In the absence of Architect's decision within the critical time, the Contractor shall proceed with the specified product.

G. Product List and Substitution Request Format:

1. Product List: Provide PDF of the list.
2. Substitution Requests: Provide PDF of requests.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: 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: Not allowed unless otherwise indicated.

C. Substitutions for Convenience: Architect will consider requests for substitution if received within days after the Notice to Proceed. 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:

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 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2500

SECTION 01 2510 - SUBSTITUTION REQUEST FORM

Project: Refer to page header above. Additional Package/Contract Info: _____

Date of Request: CM/GC Tracking No.: AE Tracking No.:

This substitution request is governed by the provisions of Section 01 2500.
__This Substitution Request is submitted during the bidding period.
__This Substitution Request is submitted with Proposed Products List dated: _____
__This Substitution Request is submitted separate from and after submittal of the Proposed Products List.

RE:

Specifications Section Title Section No. Page Paragraph

PROPOSED SUBSTITUTION:
This substitution request is governed by, and complies with, the provisions of Section 01 2500 "Substitution Procedures."

Reason for Substitution: __For Cause __For Convenience
General Description:

The accompanying attachments, per the provisions governing substitutions, provide a full description of the proposed substitution. The proposed substitution includes the following changes:
__To Contract Sum: __None __Add: __Deduct: $
__To Contract Time: __None __Add: __Deduct: __days
Assumption of Responsibility for Equal Performance
The Construction Manager/General Contractor that is submitting this request affirms that the proposed substitution conforms to required dimensions and meets or exceeds the standards of required function, appearance, and quality established by the specified product. Requester understands and affirms compliance with the provisions governing substitutions.

Requester's Name: Date:
Requesting Firm: CM or CG only

Notes:
1. Transmit substitution request to Architect's Project Manager.
2. Do not transmit substitution request as part of product submittal.
3. Do not transmit product submittal for substitution item until substitution is accepted by Owner and Architect.
4. Owner's Acceptance of substitution request is not complete until documented through addendum or contract modification.

ARCHITECT'S REVIEW:
Proposed substitution is: __Not Reviewed __Not Accepted __Accepted As Noted __Accepted
Remarks:
Name Date
cc: Owner; CM/GC, project specifier

OWNER'S REVIEW:
Proposed substitution is: __Not Reviewed __Not Accepted __Accepted As Noted __Accepted
Remarks:
Name Date
cc: Architect; CM/GC, project specifier

END OF SECTION 01 2500

SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 01 2500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.2 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, through Unifier.

1.3 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 20 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.
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: Submit through Unifier.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor 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 01 2500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Submit through Unifier.

1.4 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor through Unifier.

1.5 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive through Unifier. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2600

SECTION 01 2900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Section 01 2600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Section 01 3200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 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.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

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.
d. Schedule of Values to match with Schedule of values in Unifier.

2. Submit the schedule of values to Architect at earliest possible date, but no later than 30 days before the date scheduled for submittal of initial Applications for Payment.

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 schedule of values consistent with format of AIA Document G703.
3. 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.

1) Labor.
2) Materials.
3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. 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. Include evidence of insurance.

7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

9. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 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.

B. Payment Application Times: The period covered by each Application for Payment is one month, ending on the last day of the month.

1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

C. Application for Payment Forms: Use DFCM Application and Certificate of 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.
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 one signed and notarized copy of each Application for Payment to Architect by a method ensuring receipt within 24 hours. 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 liens 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. Submittal schedule (preliminary if not final).
5. List of Contractor's staff assignments.
6. Copies of building permits.
7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
8. Initial progress report.
9. Report of preconstruction conference.
10. Certificates of insurance and insurance policies.
11. Performance and payment bonds.
12. 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.

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. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.

8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2900

SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 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. Requests for Information (RFIs).
4. Project Document Transfer site.
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 01 3200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 01 7300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 01 7700 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

A. See University of Utah U Facilities; General Conditions; Article 5 Subcontractors; 5.1 Award of Subcontracts and Other Contracts for Portions of the Work; 5.1.1.2.

B. 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. Use CSI Form 1.5A. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

C. 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 telephone numbers, including home, office, 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, and by each temporary telephone. Keep list current at all times.

1.4 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. 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.

C. 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. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop

Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

    a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    e. Indicate required installation sequences.
    f. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Architect will review coordination drawings to confirm that 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 changes as directed and resubmit.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and Portable Data File (PDF) format.
3. 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.
c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

1.6 REQUESTS FOR INFORMATION (RFIs)

A. See University of Utah U Facilities; General Conditions; Article 7 Modifications, PRs & PCOs, PRE and Claims Process; 7.2 Contractor Initiated Requests; 7.2.1 The Request for Information (RFI) Process and Time to File

B. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

C. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number 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.

D. RFI Forms: AIA Document G716 or Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

E. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow 10 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 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 01 2600 "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.

F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:

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.

G. 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. RFI Forms: Unifier Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1.7 PROJECT INFORMATION MANAGEMENT

A. Use University of Utah’s Project Web site (Unifier System) for purposes of hosting and managing the following project communication and documentation until Final Completion. Architect’s Project Web site includes the following functions:

1. Project directory.
2. RFI forms.
3. Task and issue management.
4. Submittals forms and logs.
5. Drawing and specification document hosting, viewing, and updating.
6. Online document collaboration.
7. Reminder and tracking functions.
8. Archiving functions.

B. Architect will issue Drawings and Specifications through the Information Management Site.

C. Architect will accept and return RFIs and submittal documents only through the Project Information Management Site, unless otherwise arranged.

1.8 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.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.

3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, and Architect, within seven days of 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. Conduct the conference to review responsibilities and personnel assignments.
2. 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.
3. Agenda: Discuss items of significance that could affect progress, including the following:

a. Tentative construction schedule.
b. Critical work sequencing and long-lead items.
c. Designation of key personnel and their duties.
d. Lines of communications.
e. Procedures for processing field decisions and Change Orders.
f. Procedures for RFIs.
g. Procedures for testing and inspecting.
h. Procedures for processing Applications for Payment.
i. Submittal procedures.
j. Use of the premises.
k. Work restrictions.
l. Working hours.
m. Owner's occupancy requirements.
n. Responsibility for temporary facilities and controls.
o. Procedures for moisture and mold control.
p. Procedures for disruptions and shutdowns.
q. Construction waste management and recycling.
r. Parking availability.
s. Office, work, and storage areas.
t. Equipment deliveries and priorities.
u. First aid.
v. Security.
w. Progress cleaning.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires 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. Review of mockups.
i. Possible conflicts.
j. Compatibility requirements.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at 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.
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 utilization.
8) Temporary facilities and controls.
9) Progress cleaning.
10) Quality and work standards.
11) Status of correction of deficient items.
12) Field observations.
13) Status of RFIs.
14) Status of proposal requests.
15) Pending changes.
16) Status of Change Orders.
17) Pending claims and disputes.
18) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3100

SECTION 01 3200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's construction schedule.
2. Construction schedule updating reports.
3. Daily construction reports.
4. Site condition reports.
5. Special reports.

B. Related Requirements:

1. Section 01 3300 "Submittal Procedures" for submitting schedules and reports.
2. Section 01 4000 "Quality Requirements" for submitting a schedule of tests and inspections.

1.2 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. 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.

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. 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.

F. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.

B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

C. Construction Schedule Updating Reports: Submit with Applications for Payment.

D. Daily Construction Reports: Submit at monthly intervals.

E. Site Condition Reports: Submit at time of discovery of differing conditions.

F. Special Reports: Submit at time of unusual event.

1.4 COORDINATION

A. Coordinate Contractor's construction schedule with the schedule of values, 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.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. See University of Utah U Facilities; General Conditions; Article 4 Contractor; 4.6 Time and Contractor’s Construction Schedules; 4.6.4 Schedule Content Requirements.

B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final 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.

C. Activities: Treat each story 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 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 01 3300 "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 30 days for startup and testing.
5. 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.
6. 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. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
2. 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. Provisions for future construction.
   g. Seasonal variations.
   h. Environmental control.

3. 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.
j. Adjusting.
k. Curing.
l. Building flush-out.
m. Startup and placement into final use and operation.

4. 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. Permanent space enclosure.
d. Completion of mechanical installation.
e. Completion of electrical installation.
f. 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.

1. See University of Utah Facilities Management; General Conditions; Article 4 Contractor; 4.7 Time and Contractor's Construction Schedules; 4.7.4 Interim Completion Dates and Milestones.
2. Temporary enclosure and space conditioning.

F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

1. See Section 01 2900 "Payment Procedures" for cost reporting and payment procedures.

G. 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 Contract Time.

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, and equipment required to achieve compliance, and date by which recovery will be accomplished.

I. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. See University of Utah U Facilities; General Conditions; Article 4 Contractor; 4.6 Time and Contractor’s Construction Schedules; 4.6.2 Schedule Preparation.

B. General: Prepare network diagrams using AON (activity-on-node) format.

C. CPM Schedule: Prepare Contractor's construction schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.

a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.

D. 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.
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.

E. 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.

F. 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. Immediate 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).

G. 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.

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.

9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. 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.

2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. See University of Utah Facilities Management; General Conditions; Article 4 Contractor; 4.7 Time and Contractor’s Construction Schedules; 4.7.2 Schedule Preparation.

B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before 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. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

C. 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.
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.

END OF SECTION 01 3200

SECTION 01 3233 - 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. Periodic construction photographs.
2. Final completion construction photographs.

B. Related Requirements:

1. Section 01 7700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 01 7900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos by uploading to web-based project software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in web-based project software site:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Architect.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

1.4 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.

B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

C. Metadata: Record accurate date and time and GPS location data from camera.

D. File Names: Name media files with date and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Provide electronic photographs when specified in the Contract Documents starting with a series of photographs before the start of any physical construction, and continuing for as long as the Work progresses:

D. Preconstruction Photographs:

1. 20 photographs showing existing conditions adjacent to property before starting the Work.
2. 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.

E. Periodic Construction Photographs: Take 20 photographs monthly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

F. Final Completion Construction Photographs: Take 20 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

G. Additional Photographs: Architect 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.

H. Upon completion of the Work, submit all electronic pictures on disc. Architect may request hard copies of the pictures.

I. Secure Architect’s approval if a video tape is to be substituted for the photograph prints.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3233

SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:

1. Section 01 2900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 01 3200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 01 7823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
4. Section 01 7839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
5. Section 01 7900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require 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."

C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule 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.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. 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.

3. 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 date of fabrication.
    h. Scheduled dates for purchasing.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. See University of Utah U Facilities; General Conditions; Article 3 A/E; 3.1 A/E's Administration of the Contract; 3.1.5 A/E Review of Contractor's Submittals

B. See University of Utah U Facilities; General Conditions; Article 4 Contractor; 4.6 Time and Contractor's Construction Schedule; 4.6.8 Schedule of Submittals.

C. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.

1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.

    a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
    b. Digital Drawing Software Program: The Contract Drawings are available in Revit.
    c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

D. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

E. 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 working 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. Resubmittal Review: Allow 15 working days for review of each resubmittal.
3. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 working days for initial review of each submittal.

F. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

    a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to Owner**,** containing the following information:

    a. Project name.
    b. Date.
    c. Name and address of Architect.
    d. Name of Contractor.
    e. Name of firm or entity that prepared submittal.
    f. Names of subcontractor, manufacturer, and supplier.
    g. Category and type of submittal.
    h. Submittal purpose and description.
    i. Specification Section number and title.
    j. Specification paragraph number or drawing designation and generic name for each of multiple items.
    k. Drawing number and detail references, as appropriate.
    l. Location(s) where product is to be installed, as appropriate.

m. Related physical samples submitted directly.
n. Indication of full or partial submittal.
o. Transmittal number**,** numbered consecutively.
p. Submittal and transmittal distribution record.
q. Other necessary identification.
r. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:

a. Project name.
b. Number and title of appropriate Specification Section.
c. Manufacturer name.
d. Product name.

G. Options: Identify options requiring selection by Architect.

H. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

I. 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.

J. 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.

K. 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.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Post electronic submittals as PDF electronic files directly Document Transfer site for Project.

a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. 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 not suitable 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 showing factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

a. PDF electronic file.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

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.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
3. Submit Shop Drawings in the following format:

a. PDF electronic file.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of applicable Specification Section.
e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. 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.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

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 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.

E. 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.
5. Submit product schedule in the following format:

a. PDF electronic file.

F. Coordination Drawing Submittals: Comply with requirements specified in Section 01 3100 "Project Management and Coordination."

G. Contractor's Construction Schedule: Comply with requirements specified in Section 01 3200 "Construction Progress Documentation."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 2900 "Payment Procedures."

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 4000 "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 7700 "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Section 01 7823 "Operation and Maintenance Data."

L. 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.

M. 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.

N. 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.

O. 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.

P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. 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.

S. 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.

T. 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:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

U. 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.

V. 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.

W. 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.

X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. See University of Utah U Facilities; General Conditions; Article 3 A/E; 3.1 A/E’s Administration of the Contract; 3.1.5 A/E Review of Contractor’s Submittals

B. See University of Utah U Facilities; General Conditions; Article 4 Contractor; 4.6 Time and Contractor’s Construction Schedule; 4.6.8 Schedule of Submittals.

C. Action 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.

D. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 7700 "Closeout Procedures."

E. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date

of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. See University of Utah U Facilities; General Conditions; Article 3 A/E; 3.1 A/E's Administration of the Contract; 3.1.5 A/E Review of Contractor's Submittals.

B. See University of Utah U Facilities; General Conditions; Article 4 Contractor; 4.8 Shop Drawings, Product Data and Samples; 4.8.6 Direct Specific Attention to Revisions.

C. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

D. 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.

E. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

F. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

G. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 01 3300

SECTION 01 4000 - 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. See University of Utah U Facilities; General Conditions; Article 9 Tests and Inspections, Substantial and Final Completion, Uncovering, Correction of Work and Guaranty Period; 9.1 Tests and Inspection; 9.1.1 in General.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Requirements:

1. Divisions 02 through 33 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. See University of Utah U Facilities; General Conditions; Article 2 The University; 2.1 Information and Services Required of University; 2.1.2 Specialists and Inspectors.

B. 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.

C. 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. Services do not include contract enforcement activities performed by Architect.

D. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, 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 at testing facility to verify performance characteristics.

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 Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

J. 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, 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).

K. Experienced: When used with an entity or individual, "experienced" 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.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards 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 a decision 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.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

B. 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.

1.6 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.

5. Other required items indicated in individual Specification Sections.

C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.7 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Delegated-Design Services: For products and systems assigned to Contractor to be designed and certified by Contractor's design professional to be in compliance with performance and design criteria.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

F. 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.

G. 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.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

H. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

I. Manufacturer's 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.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated.
2. Notify Architect and testing agency seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

a. Allow seven days for initial review and each re-review of each mockup.

K. Laboratory mockups constructed at testing facility.

L. Civil Work Quality Assurance:

1. Employ an agency or staff to assure installed product and materials comply with Contract Documents, and to assure inspections, tests, and other services comply with industry standards.
2. Use an AMRL (AASHTO Materials Reference Library) certified laboratory that has personnel certified by WAQTC (Western Alliance for Quality Transportation Construction).
3. When requested by engineer, provide a professional opinion from a testing agency concerning test results and quality of work covered by testing performed.
4. Do more testing, if, in engineer’s opinion, work is not being adequately controlled.

1.8 QUALITY CONTROL

A. See University of Utah U Facilities; General Conditions; Article 2 The University; 2.1 Information and Services Required of University; 2.1.2 Specialists and Inspectors

B. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

C. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

D. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. 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 location 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 any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide 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 inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.

6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Civil Work Quality Control:

1. Testing Agency:

a. Provide sufficient personnel and cooperate with Civil Engineer and Contractor in performing testing service.
b. Obtain and secure samples using procedures specified in the applicable testing code.
c. Perform product testing in accordance with applicable requirements of the Contract Documents.
d. Correlate tests with ENGINEER's acceptance tests.
e. When an out-of-tolerance condition exists, perform additional control testing until tolerance is attained.
f. Report any non-compliance of materials and mixes to Contractor and Civil Engineer immediately.

2. Submittals – Contractor:

a. Before Construction: Identify:

1) Name, address and telephone number of testing agency.
2) Person whom agency has charged with engineering managerial responsibility.
3) Licensed professional for testing agency who is to review services.
4) Names and levels of certification and years of experience of testing agency's laboratory and field technicians.

b. During Construction: Submit quality control test data requested by Civil Engineer to demonstrate work performed complies with Contract Documents.

3. Submittals – Testing Agency:

a. During Construction: Submit field test results immediately to Civil Engineer and Contractor or not later than day of test. Submit laboratory test results within 48 hours of determination.
b. After Construction: Submit a final summary report in tabular form. Show each failed test and its corresponding passing test.
c. Reports: Include on all reports:

1) Project title, number and date.

2) Date, time and location of test.
3) Name and address of material Supplier.
4) Identification of product being tested and type of test.
5) Testing results and interpretation of results.
6) Name of technician(s) who sampled and who performed test.

4. Limits on Testing Agency:

a. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
b. Agency may not suspend work.
c. Agency has no authority to determine acceptance for Civil Engineer.
d. Samples must be collected and secured only by the testing agency.

5. Materials:

a. Material furnished from sources that have been found satisfactory under Owner's or Civil Engineer's normal testing and sampling procedures may be used in the Work.

6. Materials that are supported with a Supplier's certificate of compliance may be used in the Work. Certificate must be in possession of Contractor for review by Civil Engineer before use.

1.9 SPECIAL TESTS AND INSPECTIONS

A. See University of Utah U Facilities; General Conditions; Article 2 The University; 2.1 Information and Services Required of University; 2.1.2 Specialists and Inspectors.

B. Special Tests and Inspections: Owner will Engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

1.10 MOCK-UP PROVISIONS

A. Prepare mock-ups for Work specifically requested in specifications. Include work for Sections required to provide mock-ups.

B. Construct in locations indicated.

C. Prepare mock-ups for Architect and Testing Agency review in reasonable promptness and in orderly sequence, to not cause delays of Work.

D. Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract time and no claim for extension by reason of such default will be allowed.

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, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections 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 01 7300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

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

END OF SECTION 01 4000

SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities, to extent not already provided in previously issued bid packages.

B. Related Requirements:

1. Section 01 1000 "Summary" for work restrictions and limitations on utility interruptions.

   a. Provide temporary facilities and controls to extent not already provided.
   b. For site work, comply with mobilization and demobilization requirements per APWA (Utah) Standards: Plan 412 Invert Cover.

1.2 DEFINITIONS

A. Mobilization includes bringing all necessary equipment to the site to do the Work. It includes all labor, materials, and equipment to set up temporary offices, buildings, facilities, signs, and utilities.

B. Demobilization includes removing all construction equipment and debris so site is left clean.

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, Architect, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

C. 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.

D. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1. Locations of dust-control partitions (dust barriers) at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste handling procedures.
5. Other dust-control measures.

E. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:

1. Methods used to meet the goals and requirements of the Owner.
2. Concrete cutting method(s) to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.

1.5 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 and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.

B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

2.2 TEMPORARY FACILITIES

A. Common-Use Field Office: Inside existing Building 521, of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of 20 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
3. Drinking water and private toilet.
4. Copy machine and supplies.
5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 WIRE ROPE ROOF GUARDRAIL SYSTEMS

A. Wire Rope Guardrail Systems: Of diameter required by performance requirements, but not less than 1/2-inch-diameter, zinc-coated steel wire rope with turnbuckles, toggles, machine swage

terminals, and other fittings and accessories for securing to steel angle posts and for tightening barrier cable.

B. Delegated-Design Submittal: For wire rope guardrail systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Structural Performance: Design wire rope guardrail systems to resist a single 50-lbf concentrated applied horizontally on an area of 1 sq. ft. and a uniform 50 lbf/ft. load applied horizontally in any direction to the cable system, with anchorages or attachments capable of transferring this load to the structure.

a. Limit deflection to 18 inches.
b. Design shall assume loads are applied at a height of 18 inches above the roof surface on an area not to exceed 1 sq. ft.

C. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

D. Install wire rope guardrail systems at roof locations indicated, mounted at heights indicated on Drawings above the roof surface. Anchor wire ropes to steel angles and steel angles to walls and tension wire ropes to withstand loading as specified in "Performance Requirements" Article. Do not displace supporting components.

2.4 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 01 7700 "Closeout Procedures".

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

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 until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

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.
2. Install meters for measuring use of power, water, and gas.

B. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

D. 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.

E. 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.

1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead or underground unless otherwise indicated.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

H. Electronic Communication Service: Provide a WiFi access point, Internet service, and desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.

I. Invert Cover: Install covers as shown in APWA Plan 412 or Drawings. Installation must be tight so no debris can by-pass the cover and enterthe piping below.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.
3. Access Routes: Provide traffic plan that describes access routes for concrete trucks, delivery trucks, and other vehicles.

C. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

D. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings provided by Architect.

   a. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated.

2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

   a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.

E. Waste Disposal Facilities: Comply with requirements specified in Section 01 7419 "Construction Waste Management and Disposal."

F. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

G. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.

3.4 SITE SUPPORT FACILITIES INSTALLATION

A. Noise Control:

1. Use equipment that is equipped with noise attenuation devises. Comply with local Laws and Regulations.
2. Control construction noise in residential areas from 9:00 pm to 7:00 am.

B. Dust and Mud Control:

1. Comply with Utah State air quality regulations.
2. Provide suitable equipment to control dust or air pollution caused by construction operations.
3. Provide suitable mud and dirt containment, so Work site, access roadways and properties adjacent to the Work site are kept clean.

C. Surface Water Control:

1. Control all on-site surface water. Provide proper drainage so flooding of the site or adjacent property does not occur.
2. Provide and maintain ample means and devices with which to promptly remove and properly dispose of all water entering the site.
3. Immediately before suspension of construction operations for any reason, provide proper and necessary drainage of Work site area.
4. Provide berms or channels as necessary to prevent flooding or saturation of Subgrade. Promptly remove all water collecting in depressions.
5. Dispose of water in a manner that will not cause damage to adjacent areas or facilities.

D. Ground Water Control:

1. Provide a dewatering system sufficient to maintain excavations and foundations dry and free of water on a 24-hour basis.
2. Notify Engineer, in writing, if groundwater conditions differ from conditions shown in the Bid Documents, or in any soil test data that has been supplied.
3. Remove all dewatering facilities when no longer required.
4. Dispose of water in a manner that will not cause damage to adjacent or downstream areas or facilities.

E. Pollution Control:

1. Soil: Prevent contamination of soil from discharge of noxious substances (including engine oils, fuels, lubricants, etc.). Excavate and legally dispose of any such contaminated soil off-site, and replace with acceptable compacted fill and topsoil.
2. Water: Prevent disposal of wastes, effluent, chemicals, or other such substances adjacent to or into streams, waterways, sanitary sewers, storm drains, or public waterways. Perform any emergency measures required to contain any spillage.
3. Air: Control atmospheric pollutants.

F. Erosion Control:

1. Use measures such as berms, dikes, dams, sediment basins, fiber mat netting, gravel, mulches, slopes, drains and other erosion control devices or methods to prevent erosion and sedimentation.
2. Provide construction and earthwork methods which control surface drainage from cut, fill, borrow, and waste disposal areas, to prevent erosion and sedimentation.
3. Inspect earthwork during execution to detect any evidence of the start of erosion. Apply corrective measures as required.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 01 1000 "Summary."

C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

F. Security Enclosure and Lockup: Install 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 work day.

G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

H. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

I. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction and requirements indicated on Drawings.

1. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
2. Paint and maintain appearance of walkway for duration of the Work.

J. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.

1. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.

a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.

2. Insulate partitions to control noise transmission to occupied areas.
3. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
4. Protect air-handling equipment.
5. Provide walk-off mats at each entrance through temporary partition.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas.

2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard, replace, or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 7700 "Closeout Procedures."

END OF SECTION 01 5000

SECTION 01 56 39 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Related Requirements:

1. Section 01 50 00 "Temporary Facilities and Controls" for temporary site fencing.

1.3 DEFINITIONS

A. Caliper: Diameter of a trunk measured by a diameter tape at a height 6 inches above the ground for trees up to and including 4-inch size at this height and as measured at a height of 12 inches above the ground for trees larger than 4-inch size.

B. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape at a height 54 inches above the ground line.

C. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:

a. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
b. Arborist's responsibilities.

c. Quality-control program.
d. Coordination of Work and equipment movement with the locations of protection zones.
e. Trenching by hand or with air spade within protection zones.
f. Field quality control.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
2. Detail fabrication and assembly of protection-zone fencing and signage.
3. Indicate extent of trenching by hand or with air spade within protection zones.

C. Samples: For each type of the following:

1. Organic Mulch: 1-pint volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.

D. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For arborist and tree service firm.

B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

E. Quality-control program.

1.7 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA.

B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.8 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Moving or parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Soil: Stockpiled soil mixed with planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

1. Mixture: Well-blended mix of two parts stockpiled soil to one-part planting soil.
2. Planting Soil: Planting soil as specified in Section 32 91 15 "Soil Preparation (Performance Specification)."

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

C. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements: Previously used materials may be used when approved by Architect.

1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch opening, 0.148-inch-diameter wire chain-link fabric; with 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 rails and 0.177-inch-diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.

a. Height: 72 inches.

2. Gates: Single- swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches.

D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:

1. Text: As per Owner’s Representative.
2. Lettering: 3-inch- high minimum, white characters on red background.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag each tree trunk at 54 inches above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

3.3 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

1. Chain-Link Fencing: Install to comply with ASTM F567 and with manufacturer's written instructions.
2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
3. Access Gates: Install; adjust to operate smoothly, easily, and quietly; free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 20 feet on protection-zone fencing, but no fewer than four signs with each facing a different direction.

C. Maintain protection zones free of weeds and trash.

D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 31 20 00 "Earth Moving" unless otherwise indicated.

B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only

smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Cut Ends: Do not paint cut root ends.
3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
4. Cover exposed roots with burlap and water regularly.
5. Backfill as soon as possible according to requirements in Section 312000 "Earth Moving."

B. Root Pruning at Edge of Protection Zone: Prune tree roots 12 inches outside of the protection zone by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by arborist.

1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
3. Pruning Standards: Prune trees according to ANSI A300 (Part 1).

    a. Type of Pruning: Cleaning, reducing and thinning where indicated.

B. Unless otherwise directed by arborist and acceptable to Architect, do not cut tree leaders.

C. Cut branches with sharp pruning instruments; do not break or chop.

D. Do not paint or apply sealants to wounds.

E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.

F. Chip removed branches and dispose of off-site.

3.7 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.8 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Small Trees: Provide new trees of same size and species as those being replaced for each tree that measures 4 inches or smaller in caliper size.
2. Large Trees: Provide two new tree(s) of at least 2-inch caliper size for each tree being replaced that measures more than 4 inches in caliper size.

    a. Species: As indicated on drawings.

3. Plant and maintain new trees as specified in Section 329300 "Plants."

C. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 2-inch uniform thickness to remain.

D. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch- diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 01 56 39

SECTION 01 6000 - 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 01 2300 "Alternates" for products selected under an alternate.
2. Section 01 2500 "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.

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 01 3300 "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 01 3300 "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.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.

2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

    a. Name of product and manufacturer.
    b. Model and serial number.
    c. Capacity.
    d. Speed.
    e. Ratings.

3. See individual identification sections in Divisions 21, 22, 23, and 26 for additional identification requirements.

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 weather tight 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.

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 01 7700 "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
4. Contract Documents.
5. Where products are accompanied by the term "as selected," Architect will make selection.
6. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
7. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," 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.

   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 unless otherwise indicated by the addition of "Or As Approved" or "Or Approved Comparable Product".

   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 unless otherwise indicated by the addition of "Or As Approved" or "Or Approved Comparable Product".

   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 01 2500 "Substitution Procedures" for substitutions for convenience.

8. Reference Standards: Where Specifications describe a product by referring to a reference standard without listing product/manufacturer, propose a product that meets the standard. Where additional product description modifies the reference standard, proposed product shall meet the standard as modified.

   a. A product specified by reference standard shall comply with the requirements of the standard in effect on the date of the Bidding Documents, except:

      1) Where a date is specified with the standard; then the edition of the standard so dated shall govern.
      2) Where the governing code requires compliance to another edition of the standard.

C. Product Uniformity: It is the intent of the Documents that the completed construction be uniform throughout the Project. For each type of product, the manufacturer and model shall not vary. After a particular product has been identified and approved for an application, that product shall be used for that application across all the subcontracts and other Work-related contracts held by the Contractor or Construction Manager. This provision applies equally to accepted substitutions.

D. 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 matches.

   1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 2500 "Substitution Procedures" for proposal of product.

E. 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. The product option and selection procedure, as described in this Section, governing the specified product:

   a. Allows the Contractor to make comparable product requests.
   b. Does not require the use of the product substitution procedure.

2. 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.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.
6. By proposing a product that is not listed, for consideration as a comparable product, the Contractor affirms that it meets requirements, except where clearly indicated otherwise. Approval, if granted, will be contingent upon the product meeting requirements as comparable product. In the absence of clear indication of non-compliance in product submittal, approval of the comparable product by Architect, will be based on Contractor's affirmation, whether explicit or implicit.

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 01 6000

SECTION 01 7300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.

B. Related Requirements:

1. Section 01 1000 "Summary" for limits on use of Project site.
2. Section 01 3300 "Submittal Procedures" for submitting surveys.
3. Section 01 7700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.

2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Structural integrity of any element of Project.
5. Integrity of weather-exposed or moisture-resistant element.
6. Efficiency, maintenance, or safety of any operational element.
7. Visual qualities of sight-exposed elements.
8. Dates: Indicate when cutting and patching will be performed.
9. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

    a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

10. Include in cutting and patching plan:

    a. Identification of Project.
    b. Location and description of affected work.
    c. Necessity for cutting and patching.
    d. Description of proposed work, and products to be used.
    e. Alternatives to cutting and patching.
    f. Effect on work of Owner or separate contractor.
    g. Written permission of affected separate contractor.
    h. Date and time work will be executed.

D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

E. Certified Surveys: Submit two copies signed by land surveyor.

F. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1. Before contract closeout submit:

    a. Documentation to verify accuracy of survey work.
    b. When required by Laws and Regulations, submit a certificate signed by a licensed professional certifying that elevations and locations of improvements conform with the Contract Documents.
    c. All survey data, survey information showing dimensions, location angles and elevations of construction on contract Record Documents.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. 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.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
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.

C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

D. 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.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
3. Beginning of Modification work constitutes acceptance of existing conditions.

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. 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 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. Provide supports to assure structural integrity of surroundings, devices and methods to protect other portions of work from damage.

E. Provide protection from elements for areas which may be exposed by work.

F. 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 01 3100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."
3. Survey Reference Points:

    a. Known basic horizontal and vertical control points for the Project are indicated.
    b. Locate and protect survey control points before starting site work, and preserve all permanent reference points during construction.
    c. Notify Engineer in writing within 24 hours of any survey work changes or clarifications required for Project. Secure written authorization before making any changes or relocations.
    d. Report in writing when any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations.
    e. Replace construction stakes damaged or destroyed by Contractor at no additional cost to Owner.

F. Project Survey Requirements:

1. Any work done without line and grade established by Contractor is at Contractor's own risk.
2. Locate and layout by instrumentation and similar appropriate means to include but not limited to:

a. Pavement subgrade and finish grade.
b. Site improvements:

1) Stakes for grading, fill and topsoil placement.
2) Slope elevations.
3) Utility locations and invert elevations.

c. Batter boards for structures.
d. Retaining wall locations and elevations.
e. Curb and gutter alignment and grade.
f. Building foundations, column locations and floor levels.

G. Controlling lines and levels required for civil, mechanical, and electrical trades.

H. Installation: Comply with manufacturer's written instructions.

I. Remove and replace damaged, defective, or nonconforming Work.

3.5 SURVEY REFERENCING

A. Installation of reference marks.

B. Making permanent records of marks set.

C. Field notes in 8 1/2 inches by 11 inches format or in standard field book form. Before construction begins and after construction ends show the following:

D. All corners, points, or monuments which may be disturbed, damaged, moved, removed, covered, or destroyed by construction activity. Describe their kind, size, location, and any other data relating thereto.

1. All corners, points, or monuments which are replaced, established, or reestablished, lines of survey, bearings, basis of bearings, scale of drawing, structures containing reference marks, and picture drawings of each mark installed.
2. Found corners, points, or monuments, describing in detail the size, type, location and ownership.
3. A north arrow, length of lines, scale of drawing, weather, temperature, errors of closure, and method of adjustment.
4. Land surveyor's signature and seal on each tie-sheet record.
5. If any survey point, monument, or line is disturbed or destroyed before referencing (tie-out), reestablish that point, monument, or line at no additional cost to OWNER, and submit a record of survey plat to the governing agency to show how its location was reestablished.
6. “Corner File Report” that complies with applicable Laws and Regulations.

E. Quality Assurance:

1. Comply with all pertinent surveying codes, Laws and Regulations including but not limited to Utah State Code Title 17 Chapter 23 – County Surveyor.

F. Brass Tag:

1. Imprinted with land surveyor's license number or business name fastened with a 1 inch long brad to:
2. a 3/8-inch diameter and 1-1/4-inch-deep lead plug pounded into a hole drilled in a concrete structure, or
3. a cement water paste poured into the top of a two (2) inches diameter 24 inches long cast iron pipe driven into the ground.
4. Depress tag and brad a minimum of 1/8 inch below surface plane of concrete structure or end of pipe.

G. Rebar and Cap:

1. No. 5 deformed rebar at least 24 inches long.
2. Installed free from movement.
3. Cap bears the license number, business name, or government agency name.

H. Record of Survey

1. Mylar sheet complying with applicable Laws and Regulations for providing plat survey control.

I. Other Materials:

1. Select all other materials, not specifically described but required for proper completion of work of this Section.

J. Reference Marks:

1. Furnish and install reference marks set in concrete or mortar in sufficient number and durability to assure the perpetuation of facile replacement of any survey point, monument, or line.
2. Install reference marks where location of section corner or survey monuments are likely to be disturbed or destroyed, or where difficult terrain is encountered.
3. When specified or for new subdivision work, install reference marks for lot lines in concrete curbs or sidewalks. If not available, install witness monuments in approved locations.

K. Reference Survey Monuments Before Disturbance:

1. Obtain local jurisdiction’s monument permit not less than 72 hours before disturbing, damaging, moving, removing, covering, or destroying any existing survey monument.
2. Pay all costs and submit all pertinent data when replacing monuments not referenced.

L. Referencing Survey Points and Lines:

1. Reference all survey points and lines which may be disturbed or destroyed by construction operations using reference marks.
2. Locate reference marks on lines or extensions of lines that the survey points designate.

3.6 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Execute work by methods to avoid damage to existing structures and other work, and which will provide proper surfaces to receive patching and finishing.

J. Employ original installer if possible to be responsible for modification work on weather-exposed and moisture-resistant elements, and exposed to view surfaces.

K. Restore Work with new products per requirements of Contract Documents.

L. Fit Work, to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

A. E. Refinish surfaces to match adjacent finishes. For continuous

B. 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.

C. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.7 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.
2. Uncover work to install work done out of sequence.
3. Remove and replace defective and non-conforming work.
4. Remove Samples of installed work for testing.
5. Provide openings in non-structural elements for penetrations of mechanical and electrical work.

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 01 1000 "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, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

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.

3.8 PROGRESS CLEANING

A. See University of Utah Facilities Management; General Conditions; Article 4 Contractor; 4.9 Use of Site; 4.9.1 In General.

B. 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.
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.

C. Site: Maintain Project site free of waste materials and debris.

1. Clean exposed-to-view surfaces.
2. Remove waste, debris, and surplus materials from site. Clean grounds; paved areas and sweep clean.
3. Rake clean other surfaces.

D. 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.

E. 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.

F. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

G. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

H. 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 01 7419 "Construction Waste Management and Disposal."

I. 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.

J. 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.

K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 4000 "Quality Requirements."

3.10 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. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 7300

SECTION 01 7419 - 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. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. 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. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

C. Disposal: Removal of demolition or construction waste and subsequent salvage, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner’s property.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

1.5 PERFORMANCE GOALS

A. Salvage/Recycle Goals: Owner's intent is to salvage and recycle as much nonhazardous demolition waste as possible. Contractor is encouraged to use remaining salvageable or recyclable items to add value to the bid. Items that may be salvaged or recycled include all building and site components, packaging, and temporary construction elements.

B. Comply with Salt Lake City's sustainability initiative.

1. Website: https://www.slc.gov/sustainability/waste-management/construction-demolition-waste/

1.6 ACTION SUBMITTALS

A. Waste Management Plan: Submit 3 copies of plan within 7 days of date established for the Notice to Proceed.

1. Fill out the following form as provided by SLCgreen:

a. Salt Lake City Corporation Construction and Demolition Waste Management Plan.

1) Website http://www.slcdocs.com/slcgreen/C&D_WMgtPlan.pdf

2. Submit copy of Waste Management Plan to constructionrecycling@slcgov.com for city approval and review.

1.7 INFORMATIONAL SUBMITTALS

A. Waste Management Report: Concurrent with each Application for Payment, submit report. Include the following information:

1. Report waste management using the following form as provided by SLCgreen:

a. Salt Lake City Corporation Construction and Demolition Waste Management Report.

1) Website http://www.slcdocs.com/slcgreen/C&D_WMgtReport.pdf

2. Submit copy of Waste Management Report to constructionrecycling@slcgov.com for approval and review.

a. Construction waste report shall be filled out by the company that hauls the waste from the site and shall include at least the following:

1) Pictures
2) Itemized list of materials collected.
3) Percentage of types of waste (by weight) of the material recycled, reused, or taken to the Landfill.

3. A certificate of occupancy will be issued by the city once all of the required documents, including the waste management report, has been submitted and recorded.

B. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

C. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

D. Qualification Data: For refrigerant recovery technician.

1.8 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 01 3100 "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 plan including responsibilities of each contractor and waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.9 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to requirements in this Section. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work.

C. Waste Management Plan: To comply with city requirement, include the following:

1. Description of how minimum of 55 percent of waste will be recycled or reused.
2. Description of efforts to be employed to reduce the amount of waste generated by the project.
3. Description of procedure that will be used to train construction employees and ensure performance of proper recycling and reuse methods.

4. Listing of total amount and types of waste reused, recycled, or composted and what amount and types of the waste will be taken to the Landfill.

    a. List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

5. Names of facilities where waste materials will be taken.

    a. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
    b. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
    c. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

    1. Comply with operation, termination, and removal requirements in Section 01 5000 "Temporary Facilities and Controls."

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

    1. Distribute waste management plan to everyone concerned within three days of submittal return.
    2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

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.
    2. Comply with Section 01 5000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

D. Provide bilingual signage at dumpsters at bins.

3.2 SALVAGING DEMOLITION WASTE

A. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

B. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

C. Plumbing Fixtures: Separate by type and size.

D. Lighting Fixtures: Separate lamps by type and protect from breakage.

E. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND 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 accrue to 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.

3.4 RECYCLING DEMOLITION WASTE

A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 1-1/2-inch size.
2. Crush concrete and screen to comply with requirements in Section 31 2000 "Earth Moving" for use as satisfactory soil for fill or subbase.

B. Concrete Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 3/4-inch size.

a. Crush masonry and screen to comply with requirements in Section 31 2000 "Earth Moving" for use as general fill.

2. Clean and stack undamaged, whole masonry units on wood pallets.

C. Wood Materials: Chip demolished wood.

D. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of rebar, bolts, nuts, washers, and other rough hardware.

E. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

F. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

G. Carpet Tile: Remove debris, trash, and adhesive.

1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

H. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.

I. Conduit: Reduce conduit to straight lengths and store by material and size.

J. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

D. Paint: Seal containers and store by type.

3.6 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. Burning: Do not burn waste materials.

END OF SECTION 01 7419

SECTION 01 7700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:

1. Section 01 7300 "Execution" for progress cleaning of Project site.
2. Section 01 7823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Section 01 7839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
4. Section 01 7900 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.2 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

A. See University of Utah U Facilities; General Conditions; Article 9 Tests and Inspections, Substantial and Final Completion, Uncovering, Correction of Work and Guaranty Period; 9.3 Inspections: Substantial and Final; 9.3.1 Substantial Completion Inspection.

B. 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.

C. 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, final completion construction photographic documentation, 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 where applicable.

   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.

D. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 7900 "Demonstration and Training."
6. Advise Owner of changeover in heat and other utilities.

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, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

E. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: 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.

1.6 FINAL COMPLETION PROCEDURES

A. See University of Utah Facilities Management; General Conditions; Article 9 Tests and Inspections, Substantial and Final Completion, Uncovering, Correction of Work and Guaranty Period; 9.2 Inspections: Substantial and Final; 9.3.2 Final Completion Inspection.

B. 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 01 2900 "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.
4. Submit pest-control final inspection report.

C. 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. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 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, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

    a. MS Excel electronic file. Architect will return annotated file.

1.8 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

1. 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.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

C. 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. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.

j. 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.
k. Remove labels that are not permanent.
l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
o. 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 Standard 1992-01. Provide written report on completion of cleaning.

p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
q. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 01 5000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 7419 "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 that already show evidence of repair or restoration.

a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

C. Substantial Completion:

1. When Work, or designated portion thereof, is substantially complete, submit written notice with list of any outstanding items to be completed or corrected.
2. After receipt of Contractor's certification of Work Completion, Architect will make final inspection to determine status of completion.

D. Should Work not be substantially complete, remedy deficiencies and re- submit a written notice.

E. Acceptance of Work:

1. Protect Work until it is accepted.
2. Neither Architect’s determination that Work is complete, nor acceptance thereof by the Owner, shall operate as a bar to claim against the Contractor under the provisions of the contract documents.

F. Closeout Submittals:

1. Record Documents: Section 01 7839.
2. Operation and Maintenance Data; Section 01 7823.
3. Evidence of payment to Subcontractors and Suppliers: Document 00 7200, Final Application for Payment.
4. Final Summary Report of Contractor’s Testing Agency: Section 01 4500 requirements.

G. Sitework Closeout Schedule:

1. See APWA Plan 110 requirements.

END OF SECTION 01 7700

SECTION 01 7823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

B. Related Requirements:

1. Section 01 3300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.2 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed 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 operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.

b. Enable inserted reviewer comments on draft submittals.

2. One paper copy. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.

C. 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 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 comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

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."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.

2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for 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. 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: Enable bookmarking of 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.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-

reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.

b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.

2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. 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.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. 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.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

A. 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.

B. 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.

C. 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.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent,

and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared record Drawings in Section 01 7839 "Project Record Documents."

F. Comply with Section 01 7700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 7823

SECTION 01 7839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 01 7300 "Execution" for final property survey.
2. Section 01 7700 "Closeout Procedures" for general closeout procedures.
3. Section 01 7823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set of marked-up record prints.
2. Number of Copies: Submit copies of record Drawings as follows:

a. Submittal:

1) Submit one paper-copy set of marked-up record prints.
2) Submit record digital data files and three sets of record digital data file plots.
3) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit 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.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. See University of Utah U Facilities; General Conditions; Article 4 Contractor; 4.7 Documents and Samples at the Site, Certifying “As-Builts”.

B. 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. Depths of foundations below first floor.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Changes made by Change Order or Construction Change Directive.
   k. Changes made following Architect's written orders.
   l. Details not on the original Contract Drawings.
   m. Field records for variable and concealed conditions.
   n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record 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.

C. 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 with comment function enabled.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.
4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.

    a. See Section 01 3300 "Submittal Procedures" for requirements related to use of Architect's digital data files.

D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Format: Annotated PDF electronic file with comment function enabled.
2. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
3. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect.
    e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. See University of Utah U Facilities; General Conditions; Article 4 Contractor; 4.7 Documents and Samples at the Site, Certifying “As-Builts”.

B. 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. Note related Change Orders, record Product Data, and record Drawings where applicable.

C. Format: Submit record Specifications as annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Specifications.

2.3 RECORD PRODUCT DATA

A. See University of Utah U Facilities; General Conditions; Article 4 Contractor; 4.7 Documents and Samples at the Site, Certifying “As-Builts”.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

C. Format: Submit record Product Data as annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Product Data.

2.4 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 or scanned PDF electronic file(s) of marked-up miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. See University of Utah U Facilities; General Conditions; Article 4 Contractor; 4.7 Documents and Samples at the Site, Certifying “As-Builts”.

B. 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.

C. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

3.2 DOCUMENTS ON SITE

A. Keep at job site 1 copy of each of the following, if issued for the Work:

1. Contract Drawings.
2. Project Manual.
3. Addenda.
4. Reviewed Shop Drawings, product data and Samples.
5. Modifications to the Contract Documents.
6. Field test records.
7. Inspection certificates.
8. Manufacturer's certificates.
9. Survey documentation.
10. Storm water pollution prevention plan (SWPPP).
11. All related permits.

B. Do not use record documents for construction purposes.

C. Store Record Documents in a location, apart from documents used for construction.

D. Maintain Record Documents in a clean, dry, legible condition.

E. Provide adequate files and racks for storage of Record Documents that will allow ready access for review and updating.

F. Make Record Documents available at all times for review and Inspection by Engineer.

3.3 MARKING DEVICES

A. Red colored waterproof for all marking unless requested otherwise.

3.4 RECORDING

A. Clearly and legibly label each document "PROJECT RECORD".

B. Number Record Documents in a manner which will allow ready retrieval of documents and allow indexing of documents for submittal to Architect.

C. Update Record Documents as work occurs to show the current status of the Work.

D. Do not permanently cover or conceal any work until all required information has been recorded on the Record Documents.

E. Contract Drawings: Legibly mark contract Drawings to record following actual construction information:

1. Measured depths of various elements of foundation or finish grading in relation to finish floor datum or other permanent benchmark.
2. Measured horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
3. Measured location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of construction.
4. Field changes of dimension and detail.

5. Changes made by contract Modifications.
6. Details not contained in original contract Drawings.

F. Project Manual and Addenda: Legibly update each to record:

1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
2. Changes made by contract Modifications.
3. Other technical matters and details included in the Work, but not originally specified.

G. Shop Drawings: Maintain reviewed Shop Drawings as Record Documents; legibly annotate drawings to record changes made to Shop Drawings.

H. Product Data and Samples: Maintain reviewed product data and Samples as Record Documents; update and document any variations from the reviewed product data and Samples after acceptance.

I. Submittal of Documents:

1. At the completion of the Work, submit all Record Documents.
2. Accompany the submittal with a transmittal letter, in duplicate, containing:
3. Submittal date.
4. Project title and number.
5. Contractor's name and address.
6. Title and number of each Record Document.
7. Certification that each document as submitted is complete and accurate.

J. Signature of Contractor, or Contractor’s authorized representative.

END OF SECTION 01 7839

SECTION 01 7900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For facilitator or instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.3 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: 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 and address of videographer.
c. Name of Architect.
d. Name of Contractor.
e. Date of video recording.

2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
3. At completion of training, submit complete training manual for Owner's use in PDF electronic file format on compact disc.

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 4000 "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 01 3100 "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.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate 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.

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.
   e. Control sequences.

f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 7823 "Operation 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 an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner, through Architect, with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral performance-based test.

F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 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.

B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Architect, on electronic media.

1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
3. File Names: Utilize file names based upon 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 DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:

    a. Name of Contractor/Installer.
    b. Business address.
    c. Business phone number.
    d. Point of contact.
    e. E-mail address.

C. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

D. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

E. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 01 7900

SECTION 02 41 13

SELECTIVE SITE DEMOLITION

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Remove site structural and site utility items and dispose of them off site.

B. Salvage.

1.2 **PAYMENT PROCEDURES**

A. Payment for structures or obstructions that are not designated for removal and disposal in the Bid documents, that cannot be removed with equipment reasonably expected to be used in the work without cutting, drilling, or blasting, will be paid for **by Change Order**.

B. Backfilling depressions left because of demolition work will not be measured or paid for separately except as provided in the preceding paragraph.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 **PREPARATION**

A. Review all work procedures with ENGINEER and with representatives of any utility in the work zone.

B. Locate and preserve all active utilities which are to remain in service.

C. Implement traffic control plan requirements, Section 01 55 26.

3.2 **PROTECTION**

A. Protect irrigation systems.

B. Protect structures to be removed and their contents from vandalism and theft.

C. Protect trees:

1. Avoid or minimize damage to trees and tree roots.
2. Provide certified arborist observation of root cuts larger than four (4) inches diameter. Roots provide anchorage, storage of energy, and absorption and conduction of water and mineral elements. Loss of root connection affects health and stability of tree and safety of people and property. Notify ENGINEER of such root cut.

D. Repair or replace damage at no additional cost to OWNER.

3.2 **STRUCTURE DEMOLITION**

A. Remove structures and incidentals such as foundations, fences, outbuildings, etc.

B. Remove foundation walls at least two (2) feet below finished grade or two (2) feet below natural ground surface. Remove floor slab or break it into pieces no larger than three (3) feet square.

C. Backfilling and compaction of excavations for structures, Section 31 23 23.

D. Building components, Section 02 41 19.

3.3 **PIPELINE DEMOLITION**

A. General:

1. Abandoned pipelines not to be salvaged are considered as incidental excavation work, Section 31 23 16.
2. Do not damage pipe or structures that remain in service or are to be salvaged for OWNER.

B. Gravity Pipe Demolition:

1. Plug abandoned pipe with a permanent, water-tight concrete plug extending into the abandoned pipe at least two (2) feet.
2. Seal openings in walls of remaining manholes, catch basins, or structures with water-tight plugs.

C. Pressure Pipe Demolition:

1. Coordinate demolition with ENGINEER and agency owning the utility pipe.
2. Plug abandoned pipe with a permanent water-tight plug.
3. Cap and restrain the active pipe with a blind flange or equivalent type of plug.
4. For service line demolition or abandonment, disconnect the line from the mainline and shut off the corporation stop.

3.4 **BRIDGE AND ABUTMENT DEMOLITION**

A. Remove existing bridges and abutments indicated.

B. Remove structures so that no remaining portion is closer than three (3) feet to any water course or closer than two (2) feet to the Subgrade and Embankment surface, or within two (2) feet of the natural ground surface.

C. Remove structures so compacted backfill can be provided as required in backfilling operation, Section 31 23 23.

3.5 **BURIED FUEL TANK DEMOLITION**

A. Remove buried fuel storage tanks and dispose of tank contents in accordance with Laws and Regulations.

B. Do not spill fuel on Subgrade.

C. Comply with the local authority having jurisdiction over fuel tank

removals.

3.6 **MISCELLANEOUS DEMOLITION**

A. Remove miscellaneous structures and obstructions or cover them with backfill if the result meets the following requirements:

1. Backfill is stable.
2. Burial does not interfere with construction.
3. Permission to do so is obtained from ENGINEER.
4. No remaining portion is within two (2) feet of the final ground surface contours.

3.7 **SALVAGE**

A. Salvage designated equipment and materials for OWNER.

B. All other material becomes the property of CONTRACTOR unless such materials are not owned by OWNER.

END OF SECTION

SECTION 02 41 14

PAVEMENT REMOVAL

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Remove roadway Pavement.

B. Remove curb, gutter, sidewalk, Driveway Approach, waterway and similar flat work.

1.2 **MEASUREMENT PROCEDURES**

A. Double saw cutting required for pavement removal or T-patches will not be measured or paid for separately.

1.3 **REFERENCES**

A. **APWA (Utah) Standards**:

Plan 256 Concrete pavement patch

1.4 **SUBMITTALS**

A. Traffic control plan, Section 01 55 26.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Coordinate utility locations, Section 01 31 13.

C. Preserve all active utilities.

D. Notify neighborhood at least 48 hours before day and time of operation.

E. Mark existing utilities on redline drawings.

3.2 **PROTECTION**

A. Install Invert Covers, Section 01 71 13.

B. Trees:

1. Avoid or minimize damage to trees and tree roots.
2. Provide certified arborist observation of root cuts larger than four (4) inches diameter. Roots provide anchorage, storage of energy, and absorption and conduction of water and mineral elements. Loss of root connection affects health and stability of tree and safety of people and property. Notify ENGINEER of such root cut.

C. Existing Surfaces:
   1. Protect adjacent surfaces including concrete walls, planters, carriage walks, driveway approaches, rock walls, rock gardents concrete steps, sidewalks, and curb cut assemblies. Replace damaged facilities at no additional cost to OWNER.
   2. Use rubber cleats or Pavement pads when operating backhoes, outriggers, track equipment, or any other equipment on or crossing paved surfaces.
   3. Restore paved surfaces that are damaged by removal operations at no additional cost to the OWNER. Match the existing Pavement surface plus 1 inch.
D. Environment:
   1. Control dust, Section 01 57 00.
   2. Protect plant and animal habitat. Follow federal, state or local protection requirements.
E. Repair or replace any damage at no additional cost to OWNER.

3.3 **REMOVE PORTLAND CEMENT CONCRETE PAVEMENT**

A. See APWA Plan 256 requirements.
B. Cutting:
   1. DO NOT use machine mounted impact hammers.
   2. Make concrete cuts straight, vertical, true, full-depth.
   3. Cut along perimeter of panel to be removed. Where edge of existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.
   4. Cut along any edge that is damaged during construction, including cavities underneath caused by construction or concrete removal.
C. Removal:
   1. Remove concrete to the nearest expansion joint or vertical saw cut.
   2. Remove panels without damaging remaining panels.
   3. Remove all bonding inhibitors.

3.4 **REMOVE BITUMINOUS CONCRETE PAVEMENT**

A. Cutting:
   1. Use any method that produces a true, vertical, full-depth cut.
   2. When bituminous pavement overlays Portland cement concrete Pavement, DO NOT use machine mounted impact hammers.
   3. If an edge of an existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.
   4. Re-cut along any edge that is damaged during construction, and where cavities underneath pavement are caused by construction.
B. Remove Pavement: Remove pavement without damaging remaining.

3.5 **REMOVE CONCRETE FLAT WORK**

A. Saw cut flat work at weakened plane joints. Saw cut full depth.

B. Where edge of existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.

C. Saw along any edge that is damaged during construction, including cavities underneath caused by construction.

D. If flat work that is not scheduled for removal is damaged, remove and replace the flat work at no additional cost to OWNER.

3.6 **CLEANING**

A. Remove all debris and dust. Clean surrounding rails, sidewalks, Driveways, Driveway approaches, landscaping, concrete flat work, and other objects in vicinity of work.

END OF SECTION

SECTION 02 4119 - SELECTIVE DEMOLITION

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. Demolition and removal of selected portions of building or structure.

B. Related Requirements:

1. Section 01 1000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 01 5639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
3. Section 01 7300 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

C. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 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.

1.6 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 dust control and, for noise control. 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. Ensure Owner's building manager's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 01 3233 "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.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

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

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 COORDINATION

A. Arrange selective demolition schedule 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 ASSE A10.6 and NFPA 241.

1. Maintain the existing building structure, envelope, and interior nonstructural elements not indicated to be demolished. Do not demolish such existing construction beyond indicated limits.

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. 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 preconstruction photographs or video and templates.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

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.
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. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    c. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

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 01 5000 "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:

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 2 hours 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 01 7419 "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 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.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

D. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 07 5419 “Polyvinyl-Chloride (PVC) Roofing” for new roofing requirements.

1. Remove existing roof membrane, insulation, flashings, copings, and roof accessories.
2. Remove existing roofing system as indicated.

a. Remove existing decking where indicated.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 01 7419 "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. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 01 7419 "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. Existing Construction to Be Removed: Items and construction as indicated on Drawings.

B. Existing Items to Be Removed and Reinstalled: Items and construction as indicated on Drawings. Includes, but is not limited to, the following:

1. Server rack to server room.
2. Electrical controls to Control Room office wing.

END OF SECTION 02 4119

SECTION 03 3000 - CAST-IN-PLACE CONCRETE

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 cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.3 DEFINITIONS

A. Architectural Concrete: High-quality concrete. Architectural Concrete includes all exposed-to-view vertical concrete surfaces and concrete surfaces receiving waterproofing. Architectural concrete has no less than the following characteristics:

1. Proper and consistent alignment of form panels and form ties.
2. Absence of staining from form leakage.
3. Absence of honeycomb or excessive segregation due to improper vibration or form leakage.
4. Correct placement of rustication or other detail treatment as shown on drawings.
5. Truly square and plumb corners unless clearly directed otherwise.
6. Absence of markings from using MDF or plastic forms for formwork.

B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

C. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

D. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

E. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

    a. Contractor's superintendent.
    b. Independent testing agency responsible for concrete design mixtures.
    c. Ready-mix concrete manufacturer.
    d. Concrete Subcontractor.
    e. Special concrete finish Subcontractor.

2. Review the following:

    a. Special inspection and testing and inspecting agency procedures for field quality control.
    b. Construction movement, contraction and isolation joints.
    c. Steel-reinforcement installation.
    d. Semirigid joint fillers.
    e. Vapor-retarder installation.
    f. Anchor rod and anchorage device installation tolerances.
    g. Cold and hot weather concreting procedures.
    h. Concrete finishes and finishing.
    i. Curing procedures.
    j. Forms and form-removal limitations.
    k. Shoring and reshoring procedures.
    l. Anchor rod and anchorage device installation tolerances.
    m. Methods for achieving specified floor and slab flatness and levelness.
    n. Floor and slab flatness and levelness measurements.
    o. Concrete repair procedures.
    p. Concrete protection.
    q. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
    r. Protection of field cured field test cylinders.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Forms for cylindrical columns.
4. Void forms.
5. Form liners.
6. Insulating concrete forms.
7. Form ties.
8. Waterstops.
9. Form-release agent.
10. Each type of steel reinforcement.
11. Bar supports.
12. Mechanical splice couplers.
13. Structural thermal break insulated connection system.
14. Portland cement.

15. Fly ash.
16. Slag cement.
17. Performance-based hydraulic cement
18. Aggregates.
19. Admixtures:

    a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

20. Fiber reinforcement.
21. Vapor retarders.
22. Liquid floor treatments.
23. Curing materials.

    a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.

24. Joint fillers.
25. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Steel-fiber reinforcement content.
10. Synthetic micro-fiber content.
11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
12. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
13. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
14. Intended placement method.
15. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Reinforcement Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

3. For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars, and dimensions.
4. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

    a. Location of construction joints is subject to approval of the Architect.

D. Formwork Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.

    a. Location of construction joints is subject to approval of the Architect.

3. Indicate location of waterstops.
4. Indicate form liner layout and form line termination details.
5. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
6. Indicate layout of insulating concrete forms, dimensions, course heights, form types, and details.

E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Fiber reinforcement.
5. Waterstops.
6. Curing compounds.
7. Bonding agents.

8. Adhesives.
9. Vapor retarders.
10. Semirigid joint filler.
11. Joint-filler strips.
12. Repair materials.
13. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."

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

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Silica fume.
5. Aggregates.
6. Admixtures:
7. Steel Reinforcement:

a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

8. Mechanical splice couplers.

D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

E. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.
3. For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC353.

F. Preconstruction Test Reports: For each mix design.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

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

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

~~**E. Reinforcing Mockups: Reinforcing for cast-concrete formed surfaces, to demonstrate tolerances and standard of workmanship.**~~

~~**1. Build panel approximately 100 sq. ft. for formed surface in the location indicated on Drawings or, if not indicated, as directed by Architect.**~~
~~**2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion**~~

F. Concrete Mockups: Cast concrete slab-on-ground and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

1. Slab-On-Ground: Build panel approximately 15 feet by 15 feet in the location indicated or, if not indicated, as directed by Architect.

a. Divide panel into four equal panels to demonstrate saw joint cutting.

2. Formed Surfaces: Build panel approximately 100 sq. ft. in the location indicated or, if not indicated, as directed by Architect.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:

a. Admixture dosage rates.
b. Slump.

c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.
f. Permeability.

1.9 DELIVERY, STORAGE, AND HANDLING

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

B. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.
2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
3. Do not allow dual-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
4. Do not allow stainless steel reinforcement to come into contact with uncoated reinforcement.

C. Form Liners: Store form liners under cover to protect from sunlight.

D. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.10 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

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

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.11 WARRANTY

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

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

1.12 GUARANTEE FOR CONCRETE WORK

A. Special Guarantee: On form approved by Architect, without monetary limitation, in which manufacturer agrees to promptly repair or replace all components of concrete that fails in materials or workmanship, including material and labor, within specified guarantee period.

1. Failures include pitting, spalling, cracking, honeycombing, surface color and texture irregularities, air bubbles, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Immediately repair or replace concrete and place in satisfactory condition in every particular, any guaranteed work upon written notice from the Project Manager or Architect and make good all damage to the buildings and grounds caused by said work, without cost to the Owner.
2. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

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

2.2 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

a. For architectural concrete specified in Section 03 3300 "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

B. Design, engineer, erect, shore, brace, and maintain insulating concrete forms in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design cross ties to transfer the effects of the following loads to the cast-in-place concrete core:

a. Wind Loads: As indicated on Drawings.

1) Horizontal Deflection Limit: Not more than 1/240 of the wall height.

C. Structural Performance of Structural Thermal Break Insulating Connection System: Structural thermal break insulated connection system shall withstand the following loads and stresses:

1. Dead Loads: As indicated on Drawings.

a. Shear Load: As indicated on Drawings.
b. Bending Moment: As indicated on Drawings.

2. Live Loads: As indicated on Drawings.

a. Shear Load: As indicated on Drawings.
b. Bending Moment: As indicated on Drawings.

D. Seismic Performance of Structural Thermal Break Insulated Connection System: Structural thermal break Insulated connection system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.25

2.3 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with specified Surface Finish designations, and as follows:

a. Plywood, metal, or other approved panel materials.

1) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.

B. Architectural Concrete, High-Quality Surface, Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Furnish to conform to joint patterns and system shown on Drawings.

4. Acceptable Materials: As required to comply with specified Surface Finish designations, and as follows:

   a. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

      1) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.

   b. In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows: Class A, 1/8 inch.

C. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

   1. Provide lumber dressed on at least two edges and one side for tight fit.

D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

2.4 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Headed-Steel Reinforcing Bars: ASTM A970/A970M.

C. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60, deformed bars, assembled with clips.

D. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

E. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.5 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, ASTM A 775/A 775M epoxy coated.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

   1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.

D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain.

2.6 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.7 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
4. Silica Fume: ASTM C1240 amorphous silica.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:

a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.

2. Maximum Coarse-Aggregate Size: 1 inch nominal.
3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Lightweight Aggregate: ASTM C330/C330M, 1-inch nominal maximum aggregate size.

E. Air-Entraining Admixture: ASTM C260/C260M.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) BASF Corporation.
        2) Euclid Chemical Company (The); an RPM company.
        3) GCP Applied Technologies Inc.
        4) Sika Corporation.

8. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) BASF Corporation.
        2) Cortec Corporation.
        3) GCP Applied Technologies Inc.
        4) Sika Corporation.

G. Water and Water Used to Make Ice: ASTM C94/C94M, potable or complying with ASTM C1602/C1602M, including all limits listed in Table 2 and the requirements of paragraph 5.4

2.8 FIBER REINFORCEMENT

A. Synthetic Macro-Fiber: Synthetic macro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M, Type III, 1 to 2-1/4 inches long.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Euclid Chemical Company (The); an RPM company.
    b. FiberForce; ABC Polymer Industries, LLC.
    c. GCP Applied Technologies Inc.
    d. Sika Corporation.

2.9 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carlisle Coatings & Waterproofing Inc.
    b. CETCO, a Minerals Technologies company.
    c. Henry Company.
    d. JP Specialties, Inc.
    e. Sika Corporation.

2.10 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A, except with maximum water-vapor permeance of 0.01; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Fortifiber Building Systems Group.
    b. Raven Industries, Inc.
    c. Reef Industries, Inc.
    d. Stego Industries, LLC.
    e. W.R. Meadows, Inc.

2.11 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Curecrete Distribution Inc.; Ashford Formula.
    b. Euclid Chemical Company (The); an RPM company; Euco Diamond Hard.

c. PROSOCO, Inc; Consolideck LS.

2. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.12 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Corporation; MasterKure ER 50.
b. ChemMasters, Inc; Spray-Film.
c. Dayton Superior; AquaFilm Concentrate J74.
d. Euclid Chemical Company (The); an RPM company; Eucobar.
e. Kaufman Products, Inc; VaporAid.
f. Lambert Corporation; Lambo Skin.
g. Laticrete International, Inc.; L&M E-CON.
h. Metalcrete Industries; Waterhold.
i. Nox-Crete Products Group; Monofilm.
j. Sika Corporation; SikaFilm.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

a. Ambient Temperature Below 50 deg F: Black.
b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
c. Ambient Temperature Above 85 deg F: White.

D. Water: Potable or complying with ASTM C1602/C1602M.

E. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anti-Hydro International, Inc.
b. ChemMasters, Inc.
c. Dayton Superior.
d. Euclid Chemical Company (The); an RPM company.
e. Kaufman Products, Inc.
f. Lambert Corporation.
g. Laticrete International, Inc.

h. Nox-Crete Products Group.
i. SpecChem, LLC.
j. Vexcon Chemicals Inc.
k. W.R. Meadows, Inc.

2.13 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 according to ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
2. Form release agent for form liners shall be acceptable to form liner manufacturer.

I. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

2.14 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

C. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Silica Fume: 10 percent by mass.
4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

E. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and concrete with a w/cm below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.15 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings, grade beams, and pile caps.

1. Exposure Class: See structural drawings.
2. Minimum Compressive Strength: See structural drawings.
3. Maximum w/cm: 0.45.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Slump Flow Limit: 22 inches, plus or minus 1.5 inches.
6. Air Content:

   a. See structural drawings

7. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

B. Class B: Normal-weight concrete used for foundation walls.

1. Exposure Class: See Structural Drawings.
2. Minimum Compressive Strength: See Structural Drawings.
3. Maximum w/cm: See structural drawings.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Slump Flow Limit: 22 inches, plus or minus 1.5 inches.
6. Air Content:

   a. See Structural Drawings.

7. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

C. Class C: Normal-weight concrete used for interior slabs-on-ground.

1. Exposure Class: See Structural Drawings.
2. Minimum Compressive Strength: See structural drawings.
3. Maximum w/cm: 0.45.
4. Minimum Cementitious Materials Content: 470 lb/cu. yd.
5. Slump Limit: 4 inches, plus or minus 1 inch.
6. Slump Flow Limit: 22 inches, plus or minus 1.5 inches.
7. Air Content:

   a. See Structural Drawings. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

8. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
9. Steel-Fiber Reinforcement: Add to concrete mixture, in accordance with manufacturer's written instructions, at a rate of 50 lb/cu. yd.
10. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 4.0 lb/cu. yd.

D. Class E: Structural lightweight concrete used for interior suspended slabs.

1. Exposure Class: See Structural Drawings.
2. Minimum Compressive Strength: See structural drawings.
3. Calculated Equilibrium Unit Weight: 110 lb/cu. ft., plus or minus 3 lb/cu. ft. as determined by ASTM C567/C567M.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Slump Flow Limit: 22 inches, plus or minus 1.5 inches.
6. Air Content:

   a. See structural drawings. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

7. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

8. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 4.0 lb/cu. yd.

2.16 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified.

C. Limit concrete surface irregularities as follows:

1. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.

2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips
2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
2. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

L. Construction and Movement Joints:

1. Construct joints true to line with faces perpendicular to surface plane of concrete.
2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
3. Place joints perpendicular to main reinforcement.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.

   a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated on Drawings.

a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 PREPARATION FOR STEEL REINFORCEMENT INSTALLATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.
2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.3 STEEL REINFORCEMENT INSTALLATION

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
2. Stagger splices in accordance with ACI 318.

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

   a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

H. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating in accordance with ASTM D3963/D3963M.

3.4 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
5. Clean embedded items immediately prior to concrete placement.

3.5 INSTALLATION OF WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Protect exposed waterstops during progress of the Work.

3.6 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work.

1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.
2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.7 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.8 CONCRETE INSTALLATION EXAMINATION

A. Verification of Conditions:

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

3.9 CONCRETE INSTALLATION PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.10 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.

    a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.11 JOINTS

A. Construct joints true to line with faces perpendicular to surface plane of concrete.

A. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
2. Place joints perpendicular to main reinforcement.

    a. Continue reinforcement across construction joints unless otherwise indicated.
    b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

B. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

C. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 07 9200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

D. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.12 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Architectural Concrete: Install concrete with high-quality consistent appearance at all exposed-to-view concrete and concrete surfaces receiving waterproofing. Install and finish exposed concrete to have no less than the following characteristics:

1. Proper and consistent alignment of form panels and form ties.
2. Absence of staining from form leakage.
3. Absence of honeycomb or excessive segregation due to improper vibration or form leakage.
4. Correct placement of rustication or other detail treatment as shown on drawings.
5. Truly square and plumb corners unless clearly directed otherwise.
6. Absence of markings from formwork (i.e. use MDF or plastic forms).

F. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

a. Do not use vibrators to transport concrete inside forms.
b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

G. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.

4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.13 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

   a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
   b. Remove projections larger than 1 inch.
   c. Tie holes do not require patching.
   d. Surface Tolerance: ACI 117 Class D.
   e. Apply to concrete surfaces not exposed to public view.

2. ACI 301 Surface Finish SF-3.0:

   a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
   b. Remove projections larger than 1/8 inch.
   c. Patch tie holes.
   d. Surface Tolerance: ACI 117 Class A.
   e. Locations: Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.14 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.

3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

a. Slabs on Ground:

1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
2) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 24; and of levelness, F_L 17.

b. Suspended Slabs:

1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
2) Specified overall values of flatness, F_F 35; and of levelness, F_L 20; with minimum local values of flatness, F_F 24; and of levelness, F_L 15.

3.15 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4500 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.

    a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Cast anchor-bolt insert into bases.
    c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.16 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

    a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

        1) Recoat areas subject to heavy rainfall within three hours after initial application.

2) Maintain continuity of coating and repair damage during curing period.

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

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:

a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12-inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

c. Floors to Receive Curing Compound:

1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Maintain continuity of coating, and repair damage during curing period.
4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

3.17 TOLERANCES

A. Conform to ACI 117.

3.18 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than three days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
4. Rinse with water; remove excess material until surface is dry.
5. Apply a second coat in a similar manner if surface is rough or porous.

3.19 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s).
2. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.20 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

a. Limit cut depth to 3/4 inch.
b. Make edges of cuts perpendicular to concrete surface.
c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
d. Fill and compact with patching mortar before bonding agent has dried.
e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

a. Correct low and high areas.
b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.

    a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.

    a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
    b. Feather edges to match adjacent floor elevations.

6. Correct other low areas scheduled to remain exposed with repair topping.

    a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
    b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

    a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
    b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
    c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
    d. Place, compact, and finish to blend with adjacent finished concrete.
    e. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

    a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
    b. Dampen cleaned concrete surfaces and apply bonding agent.
    c. Place patching mortar before bonding agent has dried.
    d. Compact patching mortar and finish to match adjacent concrete.
    e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.21 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

1) Project name.
2) Name of testing agency.
3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
4) Name of concrete manufacturer.
5) Date and time of inspection, sampling, and field testing.
6) Date and time of concrete placement.
7) Location in Work of concrete represented by samples.
8) Date and time sample was obtained.
9) Truck and batch ticket numbers.
10) Design compressive strength at 28 days.
11) Concrete mixture designation, proportions, and materials.
12) Field test results.
13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.
3. Headed bolts and studs.
4. Steel-reinforcement placement.

5. Steel-reinforcement mechanical splice couplers.
6. Steel-reinforcement welding.
7. Verification of use of required design mixture.
8. Concrete placement, including conveying and depositing.
9. Curing procedures and maintenance of curing temperature.
10. Verification of concrete strength before removal of shores and forms from beams and slabs.
11. Batch Plant Inspections: On a random basis, as determined by Architect.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; ASTM C173/C173M volumetric method, for structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064/C1064M:

    a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

5. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

6. Compression Test Specimens: ASTM C31/C31M:

    a. Cast and laboratory cure two sets of three 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
    b. Cast, initial cure, and field cure two sets of three standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C39/C39M.

a. Test one set of three laboratory-cured specimens at seven days and one set of two specimens at 28 days.
b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests:

    a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

        1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 section 1.6.6.3.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

F. Manufacturer's Inspections: Engage manufacturer of structural thermal break insulated connection system to inspect completed installations prior to placement of concrete, and to provide written report that installation complies with manufacturer's written instructions.

G. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 48 hours of completion of floor finishing and promptly report test results to Architect.

3.22 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.

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

END OF SECTION 03 3000

SECTION 04 2200 - CONCRETE UNIT MASONRY

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. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry-joint reinforcement.
5. Miscellaneous masonry accessories.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

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 the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

    a. Include material test reports substantiating compliance with requirements.
    b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.
2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C1314.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
2. Density Classification: Normal weight unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Aggregate for Mortar: ASTM C144.

1. For joints less than 1/4-inch-thick, use aggregate graded with 100 percent passing the No. 16 sieve.

E. Aggregate for Grout: ASTM C404.

F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Euclid Chemical Company (The); an RPM company; Accelguard 80.
b. GCP Applied Technologies Inc.; Morset.

G. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dur-O-Wal; a Hohmann & Barnard company; D/A 810, D/A 812 or D/A 817.
b. Heckmann Building Products, Inc.; No. 376 Rebar Positioner.
c. Hohmann & Barnard, Inc; #RB or #RB-Twin Rebar Positioner.
d. Lock Rite; Rebar Positioners.
e. Wire-Bond; Core Lock Rebar Positioner.

C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.

1. Walls: Hot-dip galvanized carbon steel.
2. Wire Size for Side Rods: 0.148-inch diameter.
3. Wire Size for Cross Rods: 0.148-inch diameter.
4. Spacing of Cross Rods: Not more than 16 inches o.c.
5. Provide in lengths of not less than 10 feet.

2.7 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
2. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

B. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.

3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that reinforcing dowels are properly placed.
3. Verify that substrates are free of substances that would impair mortar bond.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2-inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.

3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

D. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.

3.8 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.9 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

E. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.

F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

G. Prism Test: For each type of construction provided, according to ASTM C1314 at 7 days and at 28 days.

3.10 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

3.11 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 2000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 2200

SECTION 04 2613 - MASONRY VENEER

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. Clay face brick.
2. Mortar.
3. Ties and anchors.
4. Embedded flashing.
5. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in masonry veneer.
2. Steel shelf angles for supporting masonry veneer.

C. Related Requirements:

1. Section 05 1200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
2. Section 07 6200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

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. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:

1. Clay face brick, in the form of straps of five or more bricks.
2. Weep vents.

D. Samples for Verification: For each type and color of the following:

1. Clay face brick, in the form of straps of five or more bricks.
2. Weep holes.
3. Accessories embedded in masonry.

1.5 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.
b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
c. For exposed brick, include test report for efflorescence according to ASTM C67.

2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.

D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down face of veneer, and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work and will be within 20 feet vertically and horizontally of a walking surface.

2.3 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Clay Face Brick: Facing brick complying with ASTM C216.

1. Grade: SW.
2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested according to ASTM C7.
3. Efflorescence: Provide brick that has been tested according to ASTM C67 and is rated "not effloresced."
4. Size (Actual Dimensions): Match existing.
5. Application: Use where brick is exposed unless otherwise indicated.
6. Provide clay face brick matching color range, texture, and size of existing adjacent brickwork.

    a. Instate Brick; University of Utah standard brick, matching existing.

7. Color and Texture: Match existing, UoU standard color and texture.

2.4 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.

E. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Euclid Chemical Company (The); an RPM company; Accelguard 80.
b. GCP Applied Technologies Inc.; Morset.

F. Water: Potable.

2.5 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.

C. Corrugated-Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.060-inch-thick, steel sheet, galvanized after fabrication.

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- diameter, hot-dip galvanized steel wire.

E. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.105-inch-thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.25-inch- diameter, hot-dip galvanized steel wire unless otherwise indicated.
4. Fabricate wire connector sections from 0.25-inch- diameter, hot-dip galvanized, carbon steel wire.
5. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
6. Seismic Masonry-Veneer Anchors: Connector section and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with projecting tabs having slotted holes for inserting vertical leg of connector section. Connector section consists of a rib-stiffened, sheet metal bent plate with down-turned leg designed to fit in anchor section slot and with integral tabs designed to engage continuous wire.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) Dur-O-Wal; a Hohmann & Barnard company; D/A 213S.
      2) Hohmann & Barnard, Inc; 200/DA 213S with DA-213S.
      3) Wire-Bond; RJ-711 (#2401) with Wire-Bond clip.

7. Seismic Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with projecting tabs having holes for inserting vertical legs of wire tie. Wire tie has sheet metal clip welded to it with integral tabs designed to engage continuous wire.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) Hohmann & Barnard, Inc; 200/DA 213-300C.
      2) Wire-Bond; RJ-711 (#2401) with Wire-Bond clip.

8. Seismic Masonry-Veneer Anchors: Connector section and a gasketed sheet metal anchor section, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch wide by 6 inches long, stamped into center to provide a slot between strap and base for inserting connector section. Self-adhering, modified bituminous gasket fits behind anchor plate and extends beyond

pronged legs. Connector section consists of a triangular wire tie and rigid PVC extrusion with snap-in grooves for inserting continuous wire.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Hohmann & Barnard, Inc; DW-10-X-Seismiclip.
2) Wire-Bond; 1004X, Type III X.

2.6 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
2. Self-Adhering Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, stainless steel with inward facing butyl block co-polymer adhesive.

a. Products: Provide one of the following:

1) York Manufacturing, Inc.; York 304 SS
2) TK Products, Inc.; TK Self-Adhering Stainless Steel TWF
3) Vapro Shield, Inc.; VaproThru-Wall Flashing SA

b. Sealant: One part 100 percent solids, solvent-free formulated silyl-terminated polyether (STPE), ASTM C920-11, Type S, Grade NS, Class 50.

1) York Manufacturing, Inc.; UniverSeal US100.
2) STS Coatings; GreatSeal LT-100.
3) Prosoco, Inc.; R-Guard Joint Seam Sealer.

3. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
4. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
5. Solder metal items at corners.

B. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is fully concealed, use metal flashing or flexible flashing.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 6200 "Sheet Metal Flashing and Trim."

1. Solder for Stainless Steel: ASTM B32, Grade Sn60, with acid flux of type recommended by stainless steel sheet manufacturer.
2. Elastomeric Sealant: ASTM C920, chemically curing urethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

E. Termination Bars for Flexible Flashing: Aluminum steel bars 0.075 inch by 1 inch.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from urethane or PVC.

B. Weep/Vent Products: Use the following unless otherwise indicated:

1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Advanced Building Products Inc.; Mortar Break Weep Mesh.
2) CavClear/Archovations, Inc.; CavClear Weep Vents.
3) Keene Building Products; Driwall Weep Vents 025.
4) Mortar Net Solutions; Mortar Net Weep Vents.

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Advanced Building Products Inc.; Mortar Break.
b. CavClear/Archovations, Inc.; CavClear Masonry Mat.
c. Heckmann Building Products, Inc.; Weep-Thru Mortar Deflector.
d. Hohmann & Barnard, Inc; Mortar Trap.
e. Mortar Net Solutions; Mortar Net with Insect Barrier.
f. Wire-Bond; Cavity Net.

2. Configuration: Provide one of the following:

a. Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.

2.8 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Products: Subject to compliance with requirements, provide the following:

    a. PROSOCO, Inc; Sure Klean® 600.

2.9 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Property Specification. Use Type N unless another type is indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

E. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

B. Lay hollow brick with face shells fully bedded in mortar and with head joints of depth equal to bed joints. At starting course, fully bed entire units, including area under cells.

1. At anchors and ties, fully bed units and fill cells with mortar as needed to fully embed anchors and ties in mortar.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:

1. Fasten seismic anchors through sheathing to wall framing and to masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed connector sections and continuous wire in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional

anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

5. Space anchors as indicated, but not more than 18 inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 24 inches, around perimeter.

B. Provide not less than 1 inch of airspace between back of masonry veneer and face of sheathing or insulation as indicated.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL

A. Anchor masonry to structural steel, where masonry abuts or faces structural steel to comply with the following:

1. Provide an open space not less than 1/2 inch wide between masonry and structural steel unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 EXPANSION JOINTS

A. General: Install expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 07 9200 "Joint Sealants."

C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 9200 "Joint Sealants," but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 FLASHING, WEEP HOLES, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under water-resistive barrier, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar.
3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/vent products or open-head joints to form weep holes.
2. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

E. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products or open-head joints to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

C. Testing Prior to Construction: One set of tests.

D. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C67 for compressive strength.

E. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 2000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 2613

SECTION 05 1200 - STRUCTURAL STEEL 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. Structural steel.
2. Shear stud connectors.
3. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 05 3100 "Steel Decking" for field installation of shear stud connectors through deck.
2. Section 05 5000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.

1.3 DEFINITIONS

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

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A6/A6M with flanges thicker than 1-1/2 inches.
2. Column base plates thicker than 2 inches.

D. Protected Zone: Structural members or portions of structural members indicated as "protected zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.

1.4 COORDINATION

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

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Forged-steel hardware.
7. Slide bearings.
8. Prefabricated building columns.
9. Shop primer.
10. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand-critical welds.
8. Identify members not to be shop primed.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand-critical welds.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

A. Installer Qualifications: A qualified installer who complies with the AISC Quality Certification Program (or Equal) and is designated an AISC-Certified Erector (or Equal), Category ACSE or Category CSE (or Equal).

1. Installers that are not AISC certified shall provide documentation, prior to bid, showing an equal level of certification and a list of recent projects of similar size and type. A list of approved alternate-AISC installers will be issued to the bidding Contractors by Addenda.

B. Shop-Painting Applicators: Qualified in accordance with AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3.

C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 341.
3. ANSI/AISC 360.
4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Option 1: Connection designs have been completed and connections indicated on the Drawings.

C. Moment Connections: Type PR, partially or Type FR, fully restrained as indicated on the structural drawings.

D. Construction: system of moment frame and braced frame.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M.

B. Channels, Angles, M-Shapes, S-Shapes: ASTM A36/A36M.

C. Plate and Bar: ASTM A36/A36M and ASTM A572/A572M.

D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.

E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

1. Weight Class: Standard.
2. Finish: Black.

F. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.

G. Steel Forgings: ASTM A668/A668M.

H. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

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

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.

D. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

A. Headed Anchor Rods: ASTM F1554, Grade 55, weldable, straight.

1. Nuts: ASTM A563 heavy-hex carbon steel.
2. Plate Washers: ASTM A36/A36M carbon steel.
3. Washers: ASTM F436, Type 1, hardened carbon steel.
4. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

B. Threaded Rods: ASTM A36/A36M.

1. Nuts: ASTM A63 heavy-hex carbon steel.
2. Washers: ASTM F436, Type 1, hardened carbon steel.
3. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.5 FORGED-STEEL STRUCTURAL HARDWARE

A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.

B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.

C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.6 PRIMER

A. Steel Primer:

1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.7 SHRINKAGE-RESISTANT GROUT

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

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

2.8 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 1.

F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.9 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.10 SHOP PRIMING

A. Shop prime all steel surfaces.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

1. SSPC-SP 3.

C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E165/E165M.
    b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    c. Ultrasonic Inspection: ASTM E164.
    d. Radiographic Inspection: ASTM E94/E94M.

4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:

    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
    b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.

5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1Mfor tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1) Liquid Penetrant Inspection: ASTM E165/E165M.

2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3) Ultrasonic Inspection: ASTM E164.
4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 05 1200

SECTION 05 3100 - STEEL DECKING

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. Roof deck.

B. Related Requirements:

1. Section 05 1200 "Structural Steel Framing" for shop- and field-welded shear connectors.
2. Section 05 5000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Roof deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

D. Research Reports: For steel deck, from ICC-ES.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ASC Profiles, Inc.
2. Canam Steel Corporation; Canam Group, Inc.
3. Cordeck.
4. DACS, Inc.
5. Epic Metals Corporation.
6. Marlyn Steel Decks, Inc.
7. New Millennium Building Systems, LLC.
8. Nucor Corp.
9. Roof Deck, Inc.
10. Valley Joist.
11. Verco Decking, Inc., a Nucor company.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 50 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

a. Color: White.

2. Deck Profile: Type WR, wide rib.
3. Profile Depth: 1-1/2 inches.
4. Design Uncoated-Steel Thickness: As indicated in the structural drawings.
5. Span Condition: As indicated in the structural drawings
6. Side Laps: Overlapped.

2.3 ACCESSORIES

A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions 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, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

A. Fasten roof-deck panels to steel supporting members as indicated in the structural drawings.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated in the structural drawings.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. mechanically fasten to substrate to provide a complete deck installation.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 REPAIR

A. Repair Painting:

1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation and apply repair paint.
2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

END OF SECTION 05 3100

SECTION 05 4000 - COLD-FORMED 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. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Load-bearing wall framing.
3. Exterior non-load-bearing wall framing.
4. Vertical deflection clips.
5. Single deflection track.
6. Drift clips.
7. Post-installed anchors.
8. Power-actuated anchors.
9. Sill sealer gasket.
10. Sill sealer gasket/termite barrier.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.

2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Certificates: For each type of code-compliance certification for studs and tracks.

D. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Miscellaneous structural clips and accessories.

E. Research Reports:

1. For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment, indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

B. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AllSteel & Gypsum Products, Inc.
2. CEMCO; California Expanded Metal Products Co.
3. ClarkDietrich.
4. Consolidated Fabricators Corp.; Building Products Division.
5. Craco Manufacturing, Inc.
6. Custom Stud.
7. Design Shapes in Steel.
8. Formetal Co. Inc. (The).
9. Jaimes Industries.
10. MarinoWARE.
11. MBA Building Supplies.
12. MRI Steel Framing, LLC.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

   a. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft..
   b. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

   a. Upward and downward movement of 1/2 inch.

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:

1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

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's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: ST50H.
2. Coating: G60, A60, AZ50, or GF30.

B. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 33.
2. Coating: G60.

2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1-5/8 inches.
3. Section Properties: As indicated on structural drawings.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches or as indicated on the structural drawings.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1-5/8 inches.
3. Section Properties: As indicated on the structural drawings.

D. Steel Single- or Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Top Flange Width: 1-5/8 inches.
3. Section Properties: As indicated on the structural drawings.

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1-5/8 inches.
3. Section Properties: As indicated on the structural drawings.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches or as indicated on the structural drawings.

C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AllSteel & Gypsum Products, Inc.
b. ClarkDietrich.
c. MarinoWARE.
d. SCAFCO Steel Stud Company.
e. Simpson Strong-Tie Co., Inc.
f. Steel Construction Systems.
g. Steeler, Inc.
h. The Steel Network, Inc.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: As indicated on the structural drawings.

E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole-reinforcing plates.
11. Backer plates.

2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01and ICC-ES AC193 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
2. Type: Torque-controlled expansion anchor.
3. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M, MIL-P-21035B or SSPC-Paint 20.

B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.9 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing 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. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

C. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 07 2100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF LOAD-BEARING WALL FRAMING

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: As shown on structural drawings.

B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch between the end of wall-framing member and the web of track.

1. Fasten both flanges of studs to top and bottom tracks.
2. Space studs as follows:

a. Stud Spacing: As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically as indicated on Drawings. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges, and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges; terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.

2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
4. Connect drift clips to cold-formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging as indicated on the structural drawings. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at centers indicated.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.7 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 4000

SECTION 05 5000 - 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 mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Slotted channel framing.
4. Shelf angles.
5. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 05 1200 "Structural Steel Framing" for steel framing, supports and other steel items attached to the structural-steel framing.

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:

1. Fasteners.
2. Shop primers.
3. Shrinkage-resisting grout.
4. Slotted channel framing.

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 mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Shelf angles.

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. Welding certificates.

C. 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.

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. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches.
2. Material: Galvanized steel, ASTM A653/A653M, commercial steel, Type B, with G90 coating; 0.108-inch nominal thickness.

F. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

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.

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.

D. 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.

E. 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.

F. 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.

G. 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.

H. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. 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.

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 and contour of welded surface matches that of adjacent surface.

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 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. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where exposed to exterior conditions.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.

2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. Galvanize and prime shelf angles located in exterior walls.

2.8 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize bearing and leveling plates.

2.9 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.

2.10 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.

2.11 STEEL AND IRON FINISHES

A. Shop prime steel prior to its delivery to the job site.

B. 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.

C. 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.

D. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless zinc-rich primer is indicated.

E. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

F. 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.

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.

B. Anchor shelf angles securely to existing construction with indicated bolts.

3.3 INSTALLATION OF BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 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.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 5000

SECTION 05 5313 - BAR GRATINGS AND CATWALKS

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 bar catwalk gratings and metal frames and supports for catwalk gratings.

B. Related Requirements:

1. Section 05 1200 "Structural Steel Framing" for structural-steel framing system components.

1.3 COORDINATION

A. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Clips and anchorage devices for gratings.

B. Shop Drawings: Include plans, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For gratings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fisher & Ludlow; a NUCOR Company.
2. Grating Pacific, Inc.
3. Harsco Industrial IKG, a division of Harsco Corporation.
4. MLP Steel Company; Laurel Steel Products Division.
5. Ohio Gratings, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design gratings.

B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Floors: Uniform load of 125 lbf/sq. ft. or concentrated load of 2000 lbf, whichever produces the greater stress.
2. Limit deflection to L/360 or 1/4 inch, whichever is less.

C. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.3 METAL BAR GRATINGS

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual " and NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."

B. Welded Steel Grating: Intension is to match existing gratings.

1. Bearing Bar Spacing: 1-3/16 inches o.c.
2. Bearing Bar Depth: 3/4 inch, but not less than as required to comply with structural performance requirements.

3. Bearing Bar Thickness: 1/8 inches, but not less than as required to comply with structural performance requirements.
4. Crossbar Spacing: 4 inches o.c.
5. Traffic Surface: Plain.
6. Steel Finish: Shop primed.

2.4 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Bars for Bar Gratings: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.

C. Wire Rod for Bar Grating Crossbars: ASTM A510.

2.5 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563 and flat washers.

C. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

A. 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.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.7 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material 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 from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and 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.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.
2. Toeplate Height: 4 inches unless otherwise indicated.

G. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

H. Do not notch bearing bars at supports to maintain elevation.

2.8 GRATING FRAMES AND SUPPORTS

A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.
2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

2.9 STEEL FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Shop prime gratings, frames, and supports unless otherwise indicated.

1. Shop prime with universal shop primer primers specified in Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting" unless primers specified in Section 09 9600 "High-Performance Coatings" are indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. 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 the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with AWS recommendations and 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.

3.2 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 5313

SECTION 06 1053 - 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, cants, and nailers.

B. Related Requirements:

1. Section 06 1600 "Sheathing" for sheathing.

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.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Fire-retardant-treated wood.
2. Power-driven fasteners.
3. Post-installed 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. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent 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, 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.

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.

E. Application: Treat items indicated on Drawings, and the following:

1. Concealed blocking.
2. Roof framing and blocking.
3. Wood cants, nailers, blocking, and similar members in connection with roofing.
4. Plywood backing panels.

2.3 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Cants.

B. 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.
2. Northern species, No. 2 Common grade; NLGA.
3. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For 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.

2.4 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 or in ground contact, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Screws for Fastening to Metal Framing: ASTM C954, 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 or ICC-ES AC193 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.

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 nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs or other structure as indicated; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Do not splice structural members between supports unless otherwise indicated.

E. 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.

F. 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.

G. 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 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.

END OF SECTION 06 1053

SECTION 06 1600 - SHEATHING

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. Wall sheathing.
2. Parapet sheathing.
3. Buttress roof plywood sheathing.
4. Sheathing joint and penetration treatment.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous Rough Carpentry" for plywood panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

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 plywood complies with requirements. Include physical properties of treated materials.
2. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
3. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Evaluation Reports: For the following, from ICC-ES:

1. Fire-retardant-treated plywood

C. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.3 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM 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. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat plywood indicated on Drawings, and the following:

1. Plywood roof sheathing at buttress roofs.

2.4 WALL SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Gypsum; CertainTeed GlasRoc Type X Sheathing.
b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
d. USG Corporation; Securock.

2. Type and Thickness: Type X, 5/8 inch thick.
3. Size: 48 by 96 inches for vertical installation.

2.5 PARAPET SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corporation; GlasRoc.
b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
d. USG Corporation; Securock.

2. Type and Thickness: Type X, 5/8 inch thick.
3. Size: 48 by 96 inches for vertical installation.

2.6 ROOF SHEATHING AT BUTTRESS ROOF

A. Plywood Sheathing: DOC PS 1, Exposure 1, Structural I sheathing.

1. Nominal Thickness: Not less than 3/4 inch.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof, parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

2.8 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

D. Coordinate roof, wall and parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Roof Sheathing at Buttress Roof:

a. Screw to cold-formed metal framing.
b. Space panels 1/8 inch apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

D. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 06 1600

SECTION 06 4116 - PLASTIC-LAMINATE-CLAD 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-clad architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.

1.3 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

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:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.

C. Samples for Verification: For the following:

1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required.

a. Provide one sample applied to core material with specified edge material applied to one edge.

2. Thermoset Decorative Panels: 8 by 10 inches, for each color, pattern, and surface finish.

a. Provide edge banding on one edge.

3. Corner Pieces:

a. Cabinet-front frame joints between stiles and rails and at 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 full-size unit for each type and finish.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer 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.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Manufacturer's Certification: Licensed participant in either AWI's Quality Certification Program or WI's Certified Compliance Program.

B. Installer Qualifications: Manufacturer of products or Installer that complies with quality requirements of either WI’s or AWI’s written standards.

C. 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 mockups of typical architectural 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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 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 25 and 55 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/concealed by construction, 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.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET MANUFACTURERS

A. Fabricators: Subject to compliance with requirements, provide products by one of the following mills, certified by either WI or AWI:

1. Firms certified by (WI) Woodworking Institute:

a. Artistic Mill.
b. Fetzer Architectural Woodwork
c. Pacific Cabinets, Inc.

2. Firms certified by (AWI) Architectural Woodworking Institute:

a. Boswell Wasatch Mill.
b. Contempo Cabinet & Mill.

c. Fetzer Architectural Woodwork
d. Granite Mill & Fixture Co.
e. Huetter Mill & Cabinet Inc.
f. Johnson Brothers Planing Mill Inc.
g. Mapleleaf Cabinets, Inc.
h. Masterpiece Commercial Millwork.
i. Pacific Cabinets, Inc.
j. Riverwoods Mill, Inc.

2.2 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Architectural Woodwork Standards Grade: Custom.

C. Type of Construction: Frameless.

D. Door and Drawer-Front Style: Flush overlay.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

1. Basis of Design: Subject to compliance with requirements, provide items M-1 indicated on Finish Legend in Drawings, by the following:

a. Abet Laminati Inc.
b. Formica Corporation.
c. Wilsonart LLC.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS.
4. Edges: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

G. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.

a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.

2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

H. Shelf Material: Medium-density fiberboard.

1. Face: 3/4-inch thermoset decorative panel (melamine) with PVC edge banding.
2. Colors, Patterns, and Finishes: As selected by Architect.

I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

J. 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.

K. Walls Surfaces Above Upper Cabinets: High-pressure decorative laminate, Grade HGS.

1. Extend plastic laminate cladding vertically up walls above upper cabinets, from top of cabinet to surface of ceiling.

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 by on Finish Legend in Drawings.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Softwood Plywood: DOC PS 1, medium-density overlay.
3. Thermoset Decorative Panels: Particleboard or MDF 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.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 7100 "Door Hardware."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Accuride International.
    b. Blum, Julius & Co., Inc.
    c. CompX International, Inc.
    d. Hardware Resources.
    e. Knape & Vogt Manufacturing Company.

B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 170 degrees of opening, self-closing.

C. Edge Pulls: Provide two pulls for drawers more than 24 inches wide.

1. Basis of Design: Sugatsune; SND-120/M Edge Pull.

    a. Size: 120mm long by 60mm deep by 19mm thick.
    b. Material: Satin nickel finish

D. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.

E. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.

F. Shelf Rests: ANSI/BHMA A156.9, B04013; metal two-pin plastic with shelf hold-down clip.

G. Drawer Slides: ANSI/BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer.

    a. Type: Full extension.
    b. Material: Epoxy-coated steel with polymer rollers.

2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-overtravel-extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
4. For drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.

H. Door Locks: ANSI/BHMA A156.11, E07121.

I. Drawer Locks: ANSI/BHMA A156.11, E07041.

J. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.

K. Grommets for Cable Passage through Cabinets: 2-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Product: Subject to compliance with requirements, provide "OG series" by Doug Mockett & Company, Inc.

L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.

1. Satin Stainless Steel: ANSI/BHMA 630.

M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.6 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.

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 humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

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 architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 06 4116

SECTION 06 6400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic sheet paneling.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.3 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.

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: Provide Item W5, as indicated on Finish Legend in the Drawings.

a. Equivalent Products: Substitutions of comparable products by other manufacturers will be considered if the product complies with specified product requirements and is approved by the interior designer.

2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

3. Nominal Thickness: Not less than 0.09 inch.
4. Surface Finish: Smooth.
5. Color: White.

2.3 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: Matching panels.

B. Adhesive: As recommended by plastic paneling manufacturer.

1. Adhesives shall have a VOC content of 50 g/L or less.

C. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 9200 "Joint Sealants."

1. Sealant shall have a VOC content of 250 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose or soluble paint and other materials that might interfere with adhesive bond.

B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.

1. Mark plumb lines on substrate at trim accessory locations for accurate installation.
2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive.

D. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

E. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.

F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 06 6400

SECTION 07 1900 - WATER REPELLENTS

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 penetrating water-repellent treatments for the following vertical and horizontal surfaces:

1. Clay brick masonry.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Water repellents shall meet performance requirements indicated without failure due to defective manufacture, fabrication, or installation.

1. Water Repellents: Comply with performance requirements specified, as determined by testing on manufacturer's standard substrate assemblies representing those indicated for this Project.

B. Water Absorption: Minimum 95 percent reduction of water absorption after 24 hours in comparison of treated and untreated specimens.

1. Clay Brick: ASTM C 67.

C. Water-Vapor Transmission: Comply with one or both of the following:

1. Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, according to ASTM E 96/E 96M.
2. Minimum 80 percent water-vapor transmission in comparison of treated and untreated specimens, according to ASTM D 1653.

D. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, according to ASTM E 514.

E. Durability: Maximum 5 percent loss of water-repellent properties after 2500 hours of weathering according to ASTM G 154 in comparison to water-repellent-treated specimens before weathering.

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Installed water repellents shall comply with performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard substrate assemblies by a qualified testing agency.

1. Select sizes and configurations of assemblies to adequately demonstrate capability of water repellents to comply with performance requirements.
2. In addition to verifying performance requirements, use test applications to verify manufacturer's written instructions for application procedure and optimum rates of product application to substrate assemblies.
3. Notify Architect seven days in advance of the dates and times when assemblies will be tested.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include manufacturer's printed statement of VOC content.
2. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Applicator.

B. Product Certificates: For each type of water repellent, from manufacturer.

C. Field quality-control reports.

D. Warranty: Special warranty specified in this Section.

1.7 QUALITY ASSURANCE

A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

B. Mockups: Apply water repellent to each type of substrate required.

1. Locate each test application as directed by Architect.
2. Size: 10 sq. ft.
3. Final approval by Architect of water-repellent application will be from test applications.

C. Preinstallation Conference: Conduct conference at Project site.

1.8 PROJECT CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:

1. Building has been closed in for not less than 30 days before treating wall assemblies.
2. Ambient temperature is above 40 deg F and below 100 deg F and will remain so for 24 hours.
3. Substrate is not frozen and substrate-surface temperature is above 40 deg F and below 100 deg F.
4. Rain or snow is not predicted within 24 hours.
5. Not less than 24 hours have passed since surfaces were last wet.
6. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.

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

PART 2 - PRODUCTS

2.1 PENETRATING WATER REPELLENTS

A. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, silane and siloxane blend with 400 g/L or less of VOCs.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Construction Chemicals, LLC; Enviroseal PBT.
b. L&M Construction Chemicals, Inc.; Hydroblock.
c. PROSOCO, Inc.; Sure Klean Weather Seal Siloxane WD.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
2. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.
3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
4. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions and as follows:

1. Clay Brick Masonry: ASTM D 5703.

B. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.

C. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.

D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply a heavy-saturation coating of water repellent, on surfaces indicated for treatment, using 15 psi- pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 07 1900

SECTION 07 2100 - 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. Extruded polystyrene foam-plastic board insulation.
2. Glass-fiber blanket insulation.

B. Related Requirements:

1. Section 07 2119 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.
2. Section 07 5423 "Thermoplastic-Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.
3. Section 09 2900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Extruded polystyrene foam-plastic board insulation.
2. 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.

1. Sign, date, and post the certification in a conspicuous location on Project site.

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.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Extruded Polystyrene Board Insulation, Type VI: ASTM C578, Type VI, 40-psi minimum compressive strength.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DiversiFoam Products.
b. Dow Chemical Company (The).
c. DuPont de Nemours, Inc.
d. Kingspan Insulation Limited.
e. Owens Corning.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
5. Thickness: As noted in drawings.

2.2 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.

d. Owens Corning.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
5. Install at exterior walls unless indicated otherwise

2.3 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AGM Industries, Inc.
b. Gemco.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.

B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AGM Industries, Inc.
b. Gemco.

2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:

a. Crawl spaces.
b. Ceiling plenums.
c. Attic spaces.

C. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch between face of insulation and substrate to which anchor is attached.

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. Gemco.

D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AGM Industries, Inc.
b. Gemco.

2.4 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

1. Adhesives shall have a VOC content of 70 g/L or less.

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.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

   1. If not otherwise indicated, extend insulation a minimum of 36 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

   1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions.
   2. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
   3. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
   4. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
   5. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.5 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 obstructions, with edges butted tightly in both directions, and with faces flush.
   2. Press units firmly against inside substrates.

3.6 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 wood-framed construction, install blankets according to ASTM C1320 and as follows:

    a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.7 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 2100

SECTION 07 2119 - FOAMED-IN-PLACE 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. Closed-cell spray polyurethane foam.

B. Related Requirements:

1. Section 07 2100 "Thermal Insulation" for foam-plastic board insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.

1. Basis-of-Design Product: Subject to compliance with requirements, provide BASF; Walltite LWP or a comparable product by one of the following:

   a. Gaco; a brand of Firestone Building Products.

2. 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: 450 or less.

3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.

B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Spray insulation to envelop entire area to be insulated and fill voids.

C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

D. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.

E. Miscellaneous Voids: Apply according to manufacturer's written instructions.

3.3 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION 07 2119

SECTION 07 2600 - VAPOR RETARDERS

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. Polyethylene vapor retarders (called “weather barrier” in drawings).

B. Related Requirements:

1. Section 03 3000 "Cast-in-Place Concrete" for under-slab vapor retarders.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 VAPOR RETARDERS

A. Provide one of the following:

1. Polyethylene Vapor Retarders:

a. Polyethylene Vapor Retarders: ASTM D4397, 10-mil- thick sheet, with maximum permeance rating of 0.1 perm.

2. Polyamide Film Vapor Retarders:

a. Polyamide Film Vapor Retarders: 2-mil- thick sheet, with maximum permeance rating of 0.1 perm.

1) Certainteed Corp.; MemBrain

2.2 ACCESSORIES

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

A. Place vapor retarders on side of construction indicated on Drawings.

B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.

D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 PROTECTION

A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION 07 2600

SECTION 07 2726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

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. Vapor-permeable, fluid-applied air barriers.

B. Related Requirements:

1. Section 06 1600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

B. VOC Content: 100 g/L or less.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E2357.

2.3 MEDIUM-BUILD AIR BARRIERS, VAPOR PERMEABLE

A. Medium-Build, Vapor-Permeable Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 17 to 30 mils over smooth, void-free substrates.

1. Basis of Design Products: GE Construction Sealants; Momentive Performance Materials Inc.; Elemax 2600.

a. Provide Basis of Design products or an equivalent product, subject to compliance with requirements, approved by Architect, one of the following:

1) DuPont Safety and Construction; DuPont Tyvek Fluid Applied WB.
2) Sto Corp; Sto AirSeal®.
3) W.R. Meadows, Inc; Air-Shield LMP.

2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E2178.
b. Vapor Permeance: Minimum 10 perms; ASTM E96/E96M, Desiccant Method, Procedure A.
c. Ultimate Elongation: Minimum 250 percent; ASTM D412, Die C.
d. Adhesion to Substrate: Minimum 30 lbf/sq. in. when tested according to ASTM D4541.
e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

f. UV Resistance: Can be exposed to sunlight for 360 days according to manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

C. Stainless-Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.

D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.; US11000 UltraSpan.
b. Pecora Corporation; Pecora XL-Span.
c. The Dow Chemical Company; Dow Corning® 123 Silicone Seal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
3. Verify that substrates are visibly dry and free of moisture.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

F. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

G. Bridge expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 ACCESSORIES INSTALLATION

A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

H. Seal top of through-wall flashings to air barrier with an additional 6-inch-wide, transition strip.

I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

B. Medium-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply an increased thickness of air-barrier material in full contact around protrusions such as masonry ties.

1. Vapor-Permeable, Medium-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, applied in one or more equal coats. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.

C. Do not cover air barrier until it has been tested and inspected by testing agency.

D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Air-barrier dry film thickness.
3. Continuous structural support of air-barrier system has been provided.
4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
5. Site conditions for application temperature and dryness of substrates have been maintained.
6. Maximum exposure time of materials to UV deterioration has not been exceeded.
7. Surfaces have been primed, if applicable.
8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
9. Termination mastic has been applied on cut edges.
10. Strips and transition strips have been firmly adhered to substrate.
11. Compatible materials have been used.
12. Transitions at changes in direction and structural support at gaps have been provided.
13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
14. All penetrations have been sealed.

D. Air barriers will be considered defective if they do not pass inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

E. Prepare inspection reports.

3.6 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 07 2726

SECTION 07 4213 - FORMED METAL WALL PANELS

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. Exposed-fastener, lap-seam metal wall panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal panel assembly during and after installation.
8. Review of procedures for repair of metal panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical metal panel assembly, including corner, supports, attachments, and accessories.
2. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration according to AAMA 501.2.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

A. Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.

B. Corrugated-Profile, Exposed-Fastener Metal Wall Panels: Formed with alternating curved ribs spaced at 2.67 inches o.c. across width of panel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AEP Span; A BlueScope Steel Company.
b. Alcoa Architectural Products (USA).

c. Berridge Manufacturing Company.
d. CENTRIA Architectural Systems.
e. Fabral.
f. Firestone Building Products.
g. MBCI.

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

   a. Nominal Thickness: 0.024 inch (24 gauge).
   b. Exterior Finish: Two-coat fluoropolymer.
   c. Color: Match existing.

3. Rib Spacing: 2.67 inches o.c.
4. Panel Coverage: 34.6 inches.
5. Panel Height: 0.875 inch.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

   1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
   2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
   3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.

E. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 4213

SECTION 07 4215 - INSULATED METAL WALL PANELS

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. Foamed-insulation-core metal wall panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal panel assembly during and after installation.
8. Review procedures for repair of metal panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical metal panel assembly, including corner, supports, attachments, and accessories.
2. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration according to AAMA 501.2.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E72:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 FOAMED-INSULATION-CORE METAL WALL PANELS

A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

1. Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.

a. Closed-Cell Content: 90 percent when tested according to ASTM D6226.
b. Density: 2.0 to 2.6 lb/cu. ft. when tested according to ASTM D1622.
c. Compressive Strength: Minimum 20 psi when tested according to ASTM D1621.

d. Shear Strength: 26 psi when tested according to ASTM C273/C273M.

B. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CENTRIA.
b. Kingspan Insulated Panels.
c. MBCI.
d. Metl-Span.

2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.028 inch.
b. Exterior Finish: Two-coat fluoropolymer.

1) Color: As selected by Architect from manufacturer's full range.

c. Interior Finish: Siliconized polyester.

1) Color: As indicated by manufacturer's designations As selected by Architect from manufacturer's full range.

3. Backer Board: On back side of exterior facing.
4. Panel Coverage: 36 inches nominal.
5. Panel Thickness: 3.0 inches.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or

premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Backer Board: Hardboard complying with ANSI A135.4, Class 1 tempered, 1/8 inch thick unless otherwise indicated.

D. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2-inch-wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

    a. Verify that weather barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
2. Install vertically.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal wall panel manufacturer.

1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 07 9200 "Joint Sealants."

3.4 INSULATED METAL WALL PANEL INSTALLATION

A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.

1. Fasten foamed-insulation-core metal wall panels to supports with fasteners at each lapped joint at location and spacing and with fasteners recommended by manufacturer.
2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
3. Provide metal-backed washers under heads of exposed fasteners on weather side of insulated metal wall panels.
4. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
5. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
6. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.

B. Foamed-Insulation-Core Metal Wall Panels: Fasten metal wall panels to supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.

1. Install clips to supports with self-tapping fasteners.

C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

D. Metal wall panels will be considered defective if they do not pass test and inspections.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 4215

SECTION 07 5419 - POLYVINYL-CHLORIDE (PVC) ROOFING

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. Mechanically fastened, polyvinyl chloride (PVC) roofing system.
2. Vapor retarder.
3. Roof insulation.
4. Cover board.
5. Walkways.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 07 6200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
3. Section 07 9200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation thickness and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:

1. Roof membrane and flashing, of color required.
2. Walkway rolls, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roof membrane and insulation, tests performed by independent qualified testing agency indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field Test Reports:

1. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

F. Field quality-control reports.

G. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed and listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Minimum 99 mph wind warranty, without NDL monetary limitation, where Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, and other components of roofing system.
2. Provide warrantee on appropriate DFCM form.
3. Warranty Period: 30 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, vapor retarders, and walkway products, for the following warranty period:

1. Provide warrantee on appropriate DFCM form.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 MH.

2.2 POLYVINYL CHLORIDE (PVC) ROOFING

A. PVC Sheet: ASTM D4434/D4434M, Type III, fabric reinforced.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Carlisle SynTec Incorporated; SureFlex PVC Membrane.
b. Flex Membrane International Corp.; Flex MF/R 60 PVC Roof Membrane.
c. GAF; EverGuard® PVC 60 mil.
d. Sika Sarnafil; SikaPlan.
e. Versico Roofing Systems; VersiFlex PVC Membrane.

2. Thickness: 60 mils.
3. Exposed Face Color: White.

B. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction. Comply with the following limits for VOC content:

a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Contact Adhesives: 80 g/L.
f. PVC Welding Compounds: 510 g/L.
g. Other Adhesives: 250 g/L.
h. Single-Ply Roof Membrane Sealants: 450 g/L.
i. Nonmembrane Roof Sealants: 300 g/L.
j. Sealant Primers for Nonporous Substrates: 250 g/L.
k. Sealant Primers for Porous Substrates: 775 g/L.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Roof Vents: As recommended by roof membrane manufacturer.

1. Size: Not less than 4-inch diameter.

E. Bonding Adhesive: Manufacturer's standard, water based.

F. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8-inch-thick; with anchors.

G. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.

H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 VAPOR RETARDER

A. Self-Adhering-Sheet Vapor Retarder: Polyethylene film laminated to layer of butyl rubber adhesive, minimum 30-mil-total thickness; maximum permeance rating of 0.1 perm; cold

applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor retarder manufacturer.

2.5 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by PVC roof membrane manufacturer, approved for use in FM Approvals' RoofNav listed roof assemblies.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Atlas EPS; a Division of Atlas Roofing Corporation.
    b. Atlas Roofing Corporation.
    c. Carlisle SynTec Incorporated.
    d. Firestone Building Products.
    e. Flex Membrane International Corp.
    f. GAF.
    g. Hunter Panels.
    h. Insulfoam; Carlisle Construction Materials Company.
    i. Rmax, Inc.

2. Compressive Strength: 24 psi.
3. Size: 48 by 48 inches.
4. Thickness:

    a. Base Layer: 1-1/2 inches.
    b. Upper Layer: Thickness as required to comply with required minimum R-value.

C. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch.
3. Slope:

    a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.6 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
2. Adhesives and sealants shall comply with the following limits for VOC content:

a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Contact Adhesives: 80 g/L.
f. PVC Welding Compounds: 510 g/L.
g. Other Adhesives: 250 g/L.
h. Single-Ply Roof Membrane Sealants: 450 g/L.
i. Nonmembrane Roof Sealants: 300 g/L.
j. Sealant Primers for Nonporous Substrates: 250 g/L.
k. Sealant Primers for Porous Substrates: 775 g/L.

D. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Georgia-Pacific Gypsum LLC; Dens Deck.
b. National Gypsum Company; DEXcell FA Glass Mat Roof Board.
c. USG Corporation; Securock Glass Mat Roof Board.

2. Thickness: 1/2 inch.
3. Surface Finish: Unprimed.

2.7 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway rolls, approximately 3/16-inch-thick and acceptable to roofing system manufacturer.

1. Size: Approximately 36 by 60 inches.
2. Color: Contrasting with roof membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.

2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 3100 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Perform fastener-pullout tests at existing steel deck according to roof system manufacturer's written instructions.

1. Submit test result within 24 hours of performing tests.

a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition.

3.4 INSTALLATION OF VAPOR RETARDER

A. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 and 6 inches, respectively.

1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
2. Seal laps by rolling.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.5 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.

    a. Locate end joints over crests of decking.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    d. At internal roof drains, slope insulation using factory-formed tapered insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches. Do not field fabricate sump profiles.

        1) Trim insulation so that water flow is unrestricted.

    e. Fill gaps exceeding 1/4 inch with insulation.
    f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
    g. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

        1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
    e. Trim insulation so that water flow is unrestricted.
    f. Fill gaps exceeding 1/4 inch with insulation.
    g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
    h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm

Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

   a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.

3.7 INSTALLATION OF MECHANICALLY FASTENED ROOF MEMBRANE

A. Mechanically fasten roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. For in-splice attachment, install roof membrane with long dimension perpendicular to steel roof deck flutes.

D. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

E. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

F. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. In-Seam Attachment: Secure one edge of PVC sheet using fastening plates or metal battens centered within seam, and mechanically fasten PVC sheet to roof deck.

I. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.

3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.8 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 INSTALLATION OF WALKWAYS

A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.

1. Install flexible walkways at the following locations:

   a. Perimeter of each rooftop unit.
   b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
   c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
   d. Top and bottom of each roof access ladder.
   e. Locations indicated on Drawings.
   f. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch clearance between adjoining rolls.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.

B. Perform the following tests:

1. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

   a. Perform tests before overlying construction is placed.
   b. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of base flashing.
   c. Flood each area for 48 hours.
   d. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

      1) Cost of retesting is Contractor's responsibility.

   e. Testing agency shall prepare survey report indicating locations of initial leaks, if any, and final survey report.

2. Testing agency shall prepare survey report indicating locations of initial discontinuities, if any.

C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

END OF SECTION 07 5419

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

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. Formed low-slope roof sheet metal fabrications.
2. Formed wall sheet metal fabrications.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 07 5419 “Polyvinyl-Chloride (PVC) Roofing” for installation of sheet metal flashing and trim integral with roofing.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Epoxy seam sealer.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of roof-penetration flashing.
8. Include details of special conditions.
9. Include details of connections to adjoining work.
10. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Evaluation Reports: For copings and roof edge flashing, from ICC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.

E. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

B. Special warranty.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. FM Approvals Listing: Manufacture and install copings and roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Stainless Steel Sheet: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.

1. Finish: ASTM A480/A480M, No. 4 (polished directional satin).

a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1) Run grain of directional finishes with long dimension of each piece.
2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation or aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 coating designation, Grade 40; prepainted by coil-coating process to comply with ASTM A755/A755M.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finish:

    a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Color: As selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

D. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Powder coated finish.
2. Color: As selected by Architect from manufacturer's full range.
3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Carlisle WIP Products; a brand of Carlisle Construction Materials; WIP 300HT.
    b. GCP Applied Technologies Inc., Grace Ice and Water Shield HT.

2. Source Limitations: Obtain underlayment from single source from single manufacturer.
3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Curb Edge Flashing: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch-wide, joint cover plates. Shop fabricate interior and exterior corners.

1. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
2. Fabricate with scuppers spaced 10 feet apart, to dimensions required with 4-inch-wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
3. Fabricate from the following materials:

a. Galvanized Steel: 0.028 inch thick.

B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.

1. Coping Profile: Profile as indicated in Drawings, in accordance with SMACNA's "Architectural Sheet Metal Manual."
2. Joint Style: Butted with expansion space and 6-inch-wide, exposed cover plate.
3. Fabricate from the following materials:

a. Galvanized Steel: 0.040 inch thick.

C. Trim and Cap: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.

1. Trim and Cap Profile: As indicated
2. Joint Style: Butted with expansion space and 6-inch-wide, exposed cover plate.
3. Fabricate from the following materials:

a. Aluminum: 0.050 inch thick.

D. Drip Edges: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

E. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

F. Flashing Receivers: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

G. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

H. Roof-Drain Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch thick.

2.7 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch thick.

B. Through-Wall Insulation Closure Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

B. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lapp joints not less than 4 inches.

3.3 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by

painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.

a. Embed hooked flanges of joint members not less than 1 inch into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.

1) Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Section 07 9200 "Joint Sealants."

3.4 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Curb Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Copings:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.

    a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch centers.
    b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints minimum of 4 inches.
4. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 INSTALLATION OF WALL FLASHINGS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.6 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 07 6200

SECTION 07 9200 - 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. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Silyl-terminated polyether joint sealants.
5. Mildew-resistant joint sealants.
6. Butyl joint sealants.
7. Latex joint sealants.

B. Related Requirements:

1. Section 07 9219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

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:

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. Field-Adhesion-Test Reports: For each sealant application tested.

D. 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.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

D. Where conflicting information is found in the Construction Documents related to products, details or dimensional discrepancies, comply with the most stringent requirements regardless of cost.

1.7 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.

1.8 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: Sealants and sealant primers shall comply with the following:

1. Architectural sealants shall have a VOC content of 250 g/L or less.
2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
3. Sealants and sealant primers for porous substrates shall have a VOC content of 775 g/L or less.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.; Silpruf NB.

b. Sika Corporation; Joint Sealants; Sikasil WS-295.
c. The Dow Chemical Company; DOW CORNING® 756 SMS BUILDING SEALANT.

2.3 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T and NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Corporation; MasterSeal NP 1 (Pre-2014: Sonolastic NP1).
b. LymTal International Inc; Iso-Flex 330.

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. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Corporation; MasterSeal SL 1 (Pre-2014: Sonolastic SL1).
b. Pecora Corporation; NR-201.
c. Polymeric Systems, Inc; Flexiprene 952.

2.4 SILYL-TERMINATED POLYETHER (STPE) JOINT SEALANTS

A. STPE, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, silyl-terminated polyether joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.; SCS7000.
b. Pecora Corporation; DynaTrol I-XL Tru-White.
c. Sika Corporation; Joint Sealants; SikaHyflex-150 LM.

2.5 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary.
b. Pecora Corporation; Pecora 860.
c. Soudal USA; RTV GP.
d. The Dow Chemical Company; DOW CORNING® 786 SILICONE SEALANT -.

2.6 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Bostik, Inc; Chem-Calk 300.
b. Pecora Corporation; BC-158.

2.7 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Everkem Diversified Products, Inc.; SilTex 40 Siliconized Acryllic Latex Caulk.
b. Franklin International; Titebond Painter's Plus Caulk.
c. Pecora Corporation; AC-20.

2.8 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. Products: Subject to compliance with requirements, provide one of the following:

a. Adfast; Adseal BR 2600.
b. Alcot Plastics Ltd.; ALCOT Soft Type Backer Rod.
c. BASF Corporation; MasterSeal 920 & 921(Pre-2014: Sonolastic Backer Rod).

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), 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.

2.9 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting 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. Unglazed surfaces of ceramic tile.

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 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 locations indicated on Drawings according to Figure 8B in ASTM C1193.
5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

    a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
    b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

    a. 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.

3. Inspect tested joints and report on the following:

    a. Whether sealants filled joint cavities and are free of voids.
    b. Whether sealant dimensions and configurations comply with specified requirements.
    c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 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.

3.6 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.

3.7 JOINT-SEALANT SCHEDULE

A. 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 metal panels.
   c. Joints between different materials listed above.
   d. Perimeter joints between materials listed above and frames of doors and windows.
   e. Control and expansion joints in overhead surfaces.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. 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.

2. Joint Sealant: Urethane, S, P, 25, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. 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 concrete walls.

2. Joint Sealant: Urethane, S, NS, 25, 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 subject to movement and required to be paintable.

1. Joint Locations:

a. Gypsum board to door and window frames, penetrating conduits and piping, light-fixtures, electrical cover plates, building specialty items, ductwork, grilles, supply diffusers, faucets, piping, escutcheon plates and similar items.

2. Joint Sealant: STPE, S, NS, 50, 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. Perimeter joints between interior wall surfaces and frames of interior doors.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

G. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:

a. Aluminum thresholds.
b. Sill plates.

2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 9200

SECTION 07 9219 - 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 07 9200 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for nonacoustical applications.

1.3 ACTION SUBMITTALS

A. Product Data: For each acoustical joint sealant.

B. 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.

C. 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.

1.5 QUALITY REQUIREMENTS

A. Where conflicting information is found in the Construction Documents related to products, details or dimensional discrepancies, comply with the most stringent requirements regardless of cost.

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. Sealant shall have a VOC content of 250 g/L or less.

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. Products: Subject to compliance with requirements, provide one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.; RCS20 Acoustical.
b. Hilti, Inc.; CP 506 Smoke and Acoustical Sealant.
c. OSI Sealants; Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
d. Pecora Corporation; AC-20 FTR.
e. USG Corporation; SHEETROCK Acoustical Sealant.

2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

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 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 07 9219

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Exterior standard steel doors and frames.
2. Interior standard steel doors and frames and interior window frames.
3. Interior standard steel borrowed lite frames.

B. Related Requirements:

1. Section 08 7100 "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.

B. Shop Drawings: Include the following:

1. Elevations of door type.
2. Details of door, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for 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 anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of glazing.

C. Samples for Verification:

1. 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.
b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

D. 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. Product Test Reports: For each type of thermally rated door assemblies for tests performed by a qualified testing agency indicating compliance with performance requirements.

B. Field quality control reports.

1.8 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. Custom Metal Products.
4. DCI Hollow Metal.
5. Deansteel Manufacturing Company, Inc.
6. Fleming Door Products Ltd.; Assa Abloy Group Company.
7. Megamet Industries, Inc.
8. Mesker Door Inc.
9. MPI Group, LLC (The).
10. North American Door Corp.
11. Philipp Manufacturing Co (The).
12. Pioneer Industries.
13. Premier Products, Inc.
14. Republic Doors and Frames.
15. Rocky Mountain Metals, Inc.
16. Shanahan's Manufacturing Limited.
17. Steelcraft; an Allegion brand.

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. when tested according to ASTM C518.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches.
c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch (nominal 18 gage).
d. Edge Construction: Model 2, Seamless.
e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
f. Typical Core: Manufacturer's standard.
g. Core at Controller Room Doors: Polyisocyanurate.

2. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (nominal 16 gage).
b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.
d. Exposed Finish: Prime.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.

1. Doors:

a. Thickness: 1-3/4 inches.
b. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (nominal 16 gage), with minimum A40 coating.
c. Edge Construction: Model 2, Seamless.
d. Edge Bevel: Provide manufacturer's standard beveled or square edges.
e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
f. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
g. Core: Polyisocyanurate.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (nominal 16 gage), with minimum A40 coating.
b. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.5 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.
3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. 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.

2.6 BORROWED LITES

A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch (nominal 16 gage).

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.7 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

D. 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.

E. Glazing: Comply with requirements in Section 08 8000 "Glazing."

2.8 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. Sidelite 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; 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.

C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
2. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
3. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.9 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.

2. 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.

3. Solidly pack mineral-fiber insulation inside frames.
4. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.

D. Glazing: Comply with installation requirements in Section 08 8000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 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. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08 1113

SECTION 08 3113 - 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 07 7200 "Roof Accessories" for roof hatches.

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.

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.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acudor Products, Inc.
b. Babcock-Davis.
c. JL Industries, Inc.; a division of the Activar Construction Products Group.
d. Larsens Manufacturing Company.
e. Maxam Metal Products Limited.
f. MIFAB, Inc.
g. Milcor; Commercial Products Group of Hart & Cooley, Inc.

h. Nystrom.
i. Williams Bros. Corporation of America (The).

2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
3. Locations: Wall.
4. Door Size: As indicated.
5. Uncoated Steel Sheet for Door: Nominal 0.060-inch, 16 gage, factory primed.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: Cam latch, screwdriver operated.

B. Flush Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acudor Products, Inc.
b. Babcock-Davis.
c. Elmdor/Stoneman Manufacturing Company; a division of Acorn Engineering Company.
d. JL Industries, Inc.; a division of the Activar Construction Products Group.
e. Larsens Manufacturing Company.
f. Maxam Metal Products Limited.
g. MIFAB, Inc.
h. Milcor; Commercial Products Group of Hart & Cooley, Inc.
i. Nystrom.
j. Williams Bros. Corporation of America (The).

2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
3. Locations: Ceiling.
4. Door Size: As indicated.
5. Uncoated Steel Sheet for Door: Nominal 0.060-inch, 16 gage, factory primed.
6. Frame Material: Same material and thickness as door.
7. Latch and Lock: Cam latch, screwdriver operated.

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.

C. Frame Anchors: Same material as door face.

D. 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.

D. 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.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

a. Color: As selected by Architect from full range of industry colors.

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 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 3113

SECTION 08 4113 - ALUMINUM-FRAMED ENTRANCES AND WINDOWS

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. Aluminum-framed windows.
2. Aluminum-framed entrance door systems.

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 construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed entrances and windows. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and windows, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
4. Include point-to-point wiring diagrams showing the following:

a. Power requirements for each electrically operated door hardware.

b. Location and types of switches, signal device, conduit sizes, and number and size of wires.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

F. Delegated-Design Submittal: For aluminum-framed entrances and windows including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Installer and field testing agency.
2. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.

B. Energy Performance Certificates: For aluminum-framed entrances and windows, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and window.

C. Product Test Reports: For aluminum-framed entrances and windows, for tests performed by a qualified testing agency.

D. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C1401. Include periodic quality-control reports.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and windows to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and accredited by the International Accreditation Service or the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement as complying with ISO/IEC 17025 and acceptable to Owner and Architect.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and windows that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including, but not limited to, excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, peeling, or chipping.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain all components of aluminum-framed entrance and window system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design aluminum-framed entrances and windows.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and windows representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and windows shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.

    a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

E. Structural: Test according to ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, window assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, window assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

G. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
2. Maximum Water Leakage: According to AAMA 501.1. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

H. Seismic Performance: Aluminum-framed entrances and windows shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

I. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

    a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.25 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
    b. Entrance Doors: U-factor of not more than 0.77 Btu/sq. ft. x h x deg F as determined according to NFRC 100.

2. Solar Heat-Gain Coefficient (SHGC):

a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.40 as determined according to NFRC 200.
b. Entrance Doors: SHGC of not more than 0.40 as determined according to NFRC 200.

3. Air Leakage:

a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested according to ASTM E283.
b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

4. Condensation Resistance Factor (CRF):

a. Fixed Glazing and Framing Areas: CRF for the system of not less than 35 as determined according to AAMA 1503.
b. Entrance Doors: CRF of not less than 57 as determined according to AAMA 1503.

J. Noise Reduction: Test according to ASTM E90, with ratings determined by ASTM E1332, as follows.

1. Outdoor-Indoor Transmission Class: Minimum 34.

K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
b. Low Exterior Ambient-Air Temperature: 0 deg F.
c. Interior Ambient-Air Temperature: 75 deg F.

2.3 WINDOW SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arcadia, Inc.
2. EFCO Corporation.
3. Kawneer North America, an Arconic company.
4. Manko Window Systems, Inc.
5. Oldcastle BuildingEnvelope™.
6. Pittco Architectural Metals, Inc.
7. Tubelite Inc.
8. U.S. Aluminum; a brand of C.R. Laurence.

9. YKK AP America Inc.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.
2. Interior Vestibule Framing Construction: Nonthermal.
3. Glazing System: Retained mechanically with gaskets on four sides.
4. Glazing Plane: Center.
5. Finish: Clear anodic finish.
6. Fabrication Method: Field-fabricated stick system.
7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
8. Steel Reinforcement: As required by manufacturer.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 ENTRANCE DOOR SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arcadia, Inc.
2. EFCO Corporation.
3. Kawneer North America, an Arconic company.
4. Manko Window Systems, Inc.
5. Oldcastle BuildingEnvelope™.
6. Pittco Architectural Metals, Inc.
7. Tubelite Inc.
8. U.S. Aluminum; a brand of C.R. Laurence.
9. YKK AP America Inc.

B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

   a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Medium stile; 3-1/2-inch nominal width.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

4. Finish: Match adjacent window framing finish.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 7100 "Door Hardware."

2.6 GLAZING

A. Glazing: Comply with Section 08 8000 "Glazing."

B. Glazing Gaskets: Comply with Section 08 8000 "Glazing."

C. Glazing Sealants: As recommended by manufacturer.

1. Sealant shall have a VOC content of 250 g/L or less.

2.7 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.

F. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.8 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Do not provide system that requires exposed fasteners

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Dead-soft, 0.018-inch-thick stainless steel, complying with ASTM A240/A240M, of type recommended by manufacturer.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

E. Rigid PVC Filler.

2.9 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from interior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 07 9200 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF OPERABLE UNITS

A. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

3.4 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 08 8000 "Glazing."

3.5 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

A. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.6 ERECTION TOLERANCES

A. Install aluminum-framed entrances and windows to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

   a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
   b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
   c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and windows.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

a. Perform a minimum of two tests in areas as directed by Architect.
b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

a. Perform a minimum of two tests in areas as directed by Architect.
b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.

C. Aluminum-framed entrances and windows will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 MAINTENANCE SERVICE

A. Entrance Door Hardware Maintenance:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide twelve months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

END OF SECTION 08 4113

SECTION 08 7100 - DOOR HARDWARE

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. Mechanical door hardware for the following:

    a. Swinging doors.

2. Electrified door hardware.

B. Related Sections include the following:

1. Section 08 1113 "Hollow Metal Doors and Frames."
2. Section 08 4113 "Aluminum-Framed Entrances and Storefronts."
3. Division 26 Sections for connections to electrical power system and for low-voltage wiring work.
4. Division 28 Section "Access Control" for access control devices installed at door openings and provided as part of a security access system.
5. Division 28 Section "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion detection system.

1.3 REFERENCED STANDARDS

A. Provide hardware in accordance with the following standards in addition to those specified in Division 01 Section “References”.

1. American National Standards Institute (ANSI), A117.1: Accessible and Usable Buildings and Facilities, edition as adopted by local Authority Having Jurisdiction (AHJ).
2. Builders Hardware Manufacturer’s Association (BHMA)

    a. ANSI/BHMA A156.13: Mortise Locks and Latches, 2012 edition
    b. ANSI/BHMA A156.3: Exit Devices, 2008 edition
    c. ANSI/BHMA A156.4: Door Controls - Closers, 2008 edition
    d. ANSI/BHMA A156.18: Materials and Finishes, 2006 edition

3. Door and Hardware Institute (DHI)

a. Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames, 2004 edition
b. Installation Guide for Doors and Hardware, 1994 edition
c. Sequence and Format for the Hardware Schedule, 2001 edition

4. National Fire Protection Association (NFPA)

a. NFPA 70: National Electrical Code, edition as adopted by local AHJ.

1.4 COORDINATION

A. Coordinate layout and installation of recessed hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system, and building control system.

D. Existing Openings: Where new hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide for proper operation.

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, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Details of electrified door hardware, indicating the following:

1. Wiring Diagrams: Power, signal, and control wiring. Include the following:

a. System schematic.
b. Point-to-point wiring diagram.
c. Riser diagram.
d. Elevation of each door.

2. Detail interface between electrified door hardware and fire alarm, access control, security, building control system.
3. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

C. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule after or concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:

a. Identification number, location, hand, size, and material of each door and frame.
b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
d. Fastenings and other installation information.
e. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
f. Mounting locations for door hardware.
g. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
h. Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.
i. List of related door devices specified in other Sections for each door and frame.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

B. Installer shall have warehousing facilities in Project's vicinity.

1. Warehousing Facilities: In Project's vicinity.

2. Scheduling Responsibility: Preparation of door hardware.

C. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

D. Supplier’s Qualifications: Must purchase products directly from the manufacturer to ensure appropriate warranty and service requirements.

E. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including excessive deflection, cracking, or breakage.
   b. Faulty operation of operators and door hardware.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three (3) years from date of Substantial Completion, except as follows:

   a. Mortise Locks: Five (5) years from date of Substantial Completion.
   b. Manual Closers: Thirty (30) years from date of Substantial Completion.
   c. Exit Devices: Three (3) years from date of Substantial Completion.
   d. Electrified Hardware Items: One (1) year from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, provide six (6) months' full maintenance by skilled employees of door hardware Installer. Provide parts and supplies same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1.	Hinges:	Ives, Hager, McKinney
2.	Locks and Latches:	Schlage, Owner's Standard
3.	Cylinders and Cores:	Furnished and keyed by Owner
4.	Exit Devices:	Von Duprin, Owner's Standard
5.	Mechanical Door Closers:	LCN, Owner's Standard
6.	Accessories and Trim:	Ives, Rockwood, Hager
7.	Weather Strip and Gasket:	Zero, National Guard, Pemko

B. Source Limitations: Obtain each type of door hardware from single manufacturer.

2.2 HINGES

A. Acceptable Products:

1.	Ives:	5BB1	5BB1HW
2.	Hager:	BB1279	BB1168
3.	McKinney:	TB2714	TB3386

B. Requirements:

1. Quantity: Provide the following, unless otherwise indicated:

    a. Two Hinges: For doors with heights up to 60 inches.
    b. Three Hinges: For doors with heights 61 to 90 inches.

2. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
3. Hinge Weight: As indicated in hardware sets.
4. Hinge Base Metal: Unless otherwise indicated, provide the following:

    a. Exterior Hinges: Stainless steel with stainless-steel pin.
    b. Interior Hinges: Steel with steel pin.
    c. Hinges for Fire-Rated Assemblies: Steel with steel pin.

5. Hinge Options: Where indicated in door hardware sets or on Drawings:

    a. Safety Stud: Designed for stud in one leaf to engage hole in opposing leaf.

b. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for out-swinging doors.
c. Corners: Square.

6. Fasteners: Comply with the following:

a. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
b. Wood Screws: For wood doors and frames.
c. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.

2.3 CONTINUOUS HINGES

A. Acceptable Products:

8.	Ives:	112XY
9.	Hager:	780-112HD
10.	Select:	SL11HD
11.	Pemko:	FMSLFHD

B. Requirements:

1. Geared Continuous Hinges: Shall utilize a single gear section for the door leaf and a separate gear section for the frame side of the door. Provide full mortise or surface applied hinge as scheduled in each set. Geared hinges are to be UL 10C tested and approved for 90 minutes.

2.4 OPERATING DOOR TRIM

A. Door Bolts

1. Acceptable Products:

a.	Ives:	FB358/FB458	DP1/DP2
b.	Rockwood:	557/555	570
c.	Hager:	283D/282D	280X
d.	Trimco:	3915/3917	3910/3911

2. Requirements:

a. Provide bolt model recommended by manufacturer for door material type.
b. Provide 1 inch throw stainless steel bolt with 12 inch length unless otherwise scheduled in the sets.
c. Provide a dust proof strike for bottom bolt at all locations where there is not a threshold.

B. Push Plates, Pull Plates, and Pulls

1. Acceptable Products:

a.	Ives:	8200	8305
b.	Rockwood:	70C	111x70C
c.	Hager:	30S	31J
d.	Trimco:	1001	1018

2. Requirements:

   a. Push Plate: Provide 6 inch by 16 inch by .050 inch push plate constructed of stainless steel. Bevel all four edges.
   b. Pull Plate: Provide 4 inch by 16 inch by .050 inch push plate constructed of stainless steel, bevel all four edges. Provide 10 inch center to center (CTC) pull constructed of stainless steel with a diameter of 1 inch.

2.5 LOCKS AND LATCHES

A. General:

1. Lock Chassis: Shall be made from steel, with locking spindles of stainless steel.
2. Latch Bolt: Shall be constructed of stainless steel with 3/4 inch throw on mortise locks and 1/2 inch throw otherwise. Latch to be deadlocking on keyed functions.
3. Lever Trim: Shall be pressure cast brass, bronze, zinc, or steel with wrought rose design. Levers are to be solid with no voids or plastic inserts.
4. Fire Rating: Lock shall be listed for up to 3 hours.
5. Strike Plates: Provide ANSI 4-7/8 inch strike plates. At pairs of doors, provide strike with 7/8 inch flat lip. At single doors, provide round-lipped strike with lip length as required to minimally clear jamb and trim. Provide dust box at each strike location.

B. Mortise Locks

1. Acceptable Products:
   a. Schlage: L Series
   b. Owner's Standard

2. Requirements:

   a. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case.
   b. Where specified, provide indicator window measuring a minimum 2 inch x 1/2 inch with 180 degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.

      1) Occupied Indicator: Provide indicator above cylinder for visibility while operating the lock that identifies the trim as occupied/unoccupied status of the door. Indicator in unoccupied state has a white background with black text and icon. Indicator in the occupied state has a red background with white text and icon.

c. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
d. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.

3. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

a. Deadbolt: Shall be constructed of stainless steel and include security roller pins. Shall have a minimum 1 inch throw.
b. Spring Cages: Lock shall have individual external spring cages for each lever.
c. Lever Spindles: Provide lockset with independent, breakaway type lever spindles. Spindles that are continuous through the lock case are not acceptable.
d. Hub Blocking: Provide lockset with a hub blocking plate to resist unauthorized entry.
e. Vandal Resistant Lever: Where scheduled, provide lockset with lever that freely rotates even when locked to resist vandalism and abuse.
f. Thumbturns: Provide thumbturns as enlarged, ADA designated style thumbturns.
g. Visual Indicator: Where scheduled, provide visual indicator showing “Vacant” or “Occupied”.

2.6 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

1. Products: Subject to compliance with requirements, provide the following Basis of Design Product or an equivalent product, approved by Architect, by one of the other following Manufacturers:

a. Basis of Design: Allegion LLC; Ives; FB458.
b. Hager Companies.
c. Trimco.

2.7 CYLINDERS AND CORES

A. Provided by Owner

B. Requirements:

1. Temporary Construction Keying: Provide each cylinder housing and/or lock lever with keyed construction core during the construction period. Cores will remain property of the contractor and will be returned upon installation of owner’s permanent key system.

2.8 EXIT DEVICES

A. Acceptable Products:

1. Von Duprin: 98/35A Series
2. Owner's Standard

2.9 MECHANICAL DOOR CLOSERS

A. General:

1. Valves: Closers shall have separate valves for latch speed, main speed, and back check. Valves shall be staked to prevent accidental removal. Internal Pressure Relief Valves (PRVs) are prohibited. Provide closers at exterior doors with "Advanced Variable Backcheck" for further protection from wind and abuse forces.
2. Provide the appropriate closer body, handing, and brackets to mount closer inside the building on the least-public side of the door.
    a. Where closers are to be mounted parallel arm, provide with heavy duty, fully forged arms.
    b. Where closers are to be mounted regular arm and the opening can otherwise be opened to 180 degrees, provide closer with the appropriate special templating to allow 180 degree door swing. Where a special template is not available for 180 degree swing, provide closer arm with integrated stop.
3. Integrated Stop Closer Arms: Where a closer with integrated stop is required, provide the appropriate closer and arm as follows:
    a. Parallel arm with spring-cushioned stop arm: Provide where door is otherwise able to open to 95 degrees and requires a parallel arm mount closer.
    b. Parallel arm with dead stop arm: Provide where door is obstructed from opening to 95 degrees and requires a parallel arm mount closer.
    c. Regular arm with push side surface-mounted overhead stop: Provide where door closer should mount on pull side of door.
4. Hold Open Arms: Provide closer arms with mechanical hold-opens as scheduled.
5. Provide closers with any special templates, brackets, plates, or other accessories required for interface with header, door, wall, and other hardware. Provide closers with screw packs containing thru-bolts, machine screws, and wood screws.
6. Closers shall be provided with all-weather fluid and shall not require readjustment from 120 degrees F to -30 degrees F. Fluid shall be non-flaming and shall not fuel door or floor covering fires. Upon request, provide data indicating thermal properties of fluid.
7. Closers shall close and latch door when adjusted to meet accessibility requirements for door opening force: 8.5 lbs at exterior doors, 5 lbs at interior doors, and 15 lbs at labeled fire doors.

B. Heavy Duty Door Closers:

1. Acceptable Products:
    a. LCN: 4011/4111/4040XP
    b. Owner's Standard
2. Requirements:

a. ANSI Grade: BHMA/ANSI A156.4, Grade 1.
b. Closer Construction: Closer shall have cast iron body with 1-1/2 inch steel piston, double heat treated pinion, 5/8 inch bearing journals, and full complement needle or caged ball bearings. Closer shall be adjustable from sizes 1 through 6.
c. Provide closers with spring size adjustment dial for ease of adjusting.

2.10 ARCHITECTURAL DOOR TRIM

A. Protection Plates

1. Acceptable Products:

a.	Ives:	8400 Series
b.	Rockwood:	K1050
c.	Hager:	194S
d.	Trimco:	K Series

2. Requirements:

a. Provide .050 inch thick stainless steel protection plates with height as scheduled. Plate shall have four beveled edges and countersunk screws.

B. Door Stops and Holders

1. Acceptable Products:

a.	Ives:	FS439	WS406/407
b.	Rockwood:	441H	405/406
c.	Hager:	242F	236W

2. Requirements:

a. Provide stops and holders as indicated in the hardware sets.
b. Where wall bumpers are scheduled, provide concave rubber bumper where the adjacent lever trim incorporates a push-button. Otherwise, provide convex rubber bumpers.

2.11 OVERHEAD STOPS AND HOLDERS

A. Acceptable Products:

1.	Glynn Johnson:	100 Series	90 Series
2.	ABH:	1000 Series	9000 Series

B. Requirements:

1. Provide overhead stops and holders as scheduled, sized per manufacturer’s recommendations based on door width.
2. Provide concealed overhead stops with adjustable jamb bracket.

3. Where possible without conflicting with other hardware, mount surface overhead stops on least public side of door.
4. Provide stops with any special templates, brackets, plates, or other accessories required for interface with header, door, wall, and other hardware.

2.12 SADDLE AND PANIC THRESHOLDS

A. Acceptable Products:

1. Zero International: 655A
2. National Guard: 425HD
3. Pemko: 1715A

B. Requirements:

1. Saddle thresholds: Provide with length equal to the width of the opening.
2. Provide stainless steel machine screws and lead anchors for each threshold.

2.13 WEATHERSTRIP AND GASKET

A. General:

1. Provide weather strip and gasketing as scheduled.
2. Size weather strip and gasket to provide a continuous seal around opening and at meeting stiles.

B. Perimeter Seals

1. Acceptable Products:

a. Zero: 488S-BK 429A
b. National Guard: 5050B 700SA
c. Pemko: S88D 2891AS

C. Astragals, Meeting Stiles, and Mullion Seals

1. Acceptable Products:

a. Zero: 43SP 8780N
b. National Guard: 139A 5100
c. Pemko: 357C 5100SB

2. Requirements

a. Where overlapping astragals are scheduled on exterior doors, provide with thru-bolts.
b. Where overlapping astragals are scheduled on out-swinging doors, provide for mounting on the pull-side of the active leaf. Otherwise, provide for mounting on the push-side of the inactive leaf.

D. Door Bottoms

1. Acceptable Products:

a. Zero: 39A
b. National Guard: 200NA
c. Pemko: 3452CNB

2.14 MISCELLANEOUS HARDWARE

A. Silencers

1. Acceptable Products:

a. Ives: SR64
b. Rockwood: 608
c. Hager: 307D
d. Trimco: 1229A

2. Requirements:

a. Where indicated on single openings, provide 3 each rubber silencers on lock jamb.
b. Where indicated on paired openings, provide 2 each rubber silencers on header.

2.15 ELECTRONIC ACCESSORIES

A. Electric Power Transfers

1. Acceptable Products:

a. Von Duprin: EPT-10

2. Requirements:

a. Provide edge-mounted electric power transfer with either two 18 gauge wires or ten 24 gauge wires as scheduled.

B. Door Contacts

1. Acceptable Products:

a. Schlage Electronics: 679-05
b. Securitron: DPS Series
c. Security Door Controls: MC-4

2. Requirements:

a. Provide concealed, edge-mounted door contacts as appropriate for door/frame material.

2.16 FINISHES

A. Match items to the manufacturer's standard color and texture finish for the latch and locksets (or push-pull units if no latch or locksets).

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

C. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

D. The designations used in schedules and elsewhere to indicate hardware finishes are the industry-recognized standard commercial finishes, except as otherwise noted.

1. Brushed Chrome and/or Stainless Steel Appearance

   a. Brushed Stainless Steel, no coating: ANSI 630.
   b. Satin Chrome, Clear Coated: ANSI 626, ANSI 652.
   c. Powder Coated Aluminum finish: ANSI 689.
   d. Saddle and Panic Thresholds: Mill Aluminum finish.
   e. Weatherstrip and Gasket: Clear Anodized Aluminum finish.

2.17 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

B. Steel Doors and Frames: Comply with DHI A115 Series.

1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

3.3 INSTALLATION

A. Pre-installation conference shall be conducted prior to installation of hardware at Project site. Meet with the, Owner, Contractor, installer, and manufacturer’s representatives. A separate pre-installation conference shall be conducted prior to the installation of electronic security hardware with the electrical contractor Review catalogs, brochures, templates, installation instructions, and the approved hardware schedule. Survey installation procedures and workmanship, with special emphasis on unusual conditions, as to ensure correct technique of installation, and coordination with other work. Notify participants at least ten, 10 working days before conference.

B. Hardware Installers must have a minimum of five (5) years’ experience in installation of hardware. Provide verification of installer’s qualification to Consultant for approval. All installers to attend review meetings with the hardware distributor.

C. Install hardware using only manufacturer supplied and approved fasteners in strict adherence with manufacturers published installation instructions.

D. Install head seal prior to installation of “PA”-parallel arm mounted door closers and push side mounted door stops/holders. Trim, cut and notch thresholds and saddles neatly to minimally fit the profile of the door frame. Install thresholds and saddles in a bed of caulking completely sealing the underside from water and air penetration.

E. Mounting Heights: Mount door hardware units at heights indicated, as follows, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."

F. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Furnish wiring diagrams to electrical contractor for use in installing electrical hardware products.

1. Electrical contractor to run all wiring and make all final connections for electrified hardware. Hardware supplier shall be responsible to furnish all wiring diagrams to operate electrified hardware. Access control material and electrified hardware to interface at junction boxes.

3.4 FIELD QUALITY CONTROL

A. Architectural Hardware Consultant: Architect shall engage a qualified Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

B. Architectural Hardware Consultant shall inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.8 DOOR HARDWARE SETS

A. The following schedule of hardware sets shall be considered a guide and the supplier is cautioned to refer to general conditions, special conditions, and the full requirements of this section. It shall be the hardware supplier's responsibility to furnish all required hardware.

B. Where items of hardware are not definitely or correctly specified and are required for completion of the Work, a written statement of such omission, error, conflict, or other discrepancy shall be sent to the Architect, prior to date specified for receipt of bids, for clarification by addendum.

C. Adjustments to the Contract Sum will not be allowed for omissions or items of hardware not clarified prior to bid opening

3.9 DOOR HARDWARE SCHEDULE

~~**HW SET: 01**~~
~~**DOOR NUMBER: (INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING DOORS)**~~
~~120~~

~~6~~	~~EA~~	~~HINGE~~	~~5BB1HW 4.5 X 4.5 NRP~~	~~630~~	~~IVE~~
~~2~~	~~EA~~	~~MANUAL FLUSH BOLT~~	~~FB458~~	~~626~~	~~IVE~~
~~1~~	~~EA~~	~~DUST PROOF STRIKE~~	~~DP2~~	~~626~~	~~IVE~~
~~1~~	~~EA~~	~~STOREROOM W/DEADBOLT~~	~~L9480L 06A~~	~~626~~	~~SCH~~
~~1~~	~~EA~~	~~MORTISE CYLINDER~~	~~PROVIDED BY UU~~	~~626~~	~~B/O~~
~~1~~	~~EA~~	~~OH STOP & HOLDER~~	~~90H (INACTIVE LEAF)~~	~~630~~	~~GLY~~
~~1~~	~~EA~~	~~SURFACE CLOSER~~	~~4040XP SHCUSH MC TBWMS (ACTIVE LEAF ONLY)~~	~~689~~	~~LCN~~
~~1~~	~~EA~~	~~GASKETING~~	~~188SBK (ASTRAGAL)~~	~~BK~~	~~ZER~~
~~1~~	~~SET~~	~~GASKETING~~	~~429AA-S~~	~~AA~~	~~ZER~~
~~1~~	~~EA~~	~~SECURITY ASTRAGAL~~	~~43SP (ACTIVE LEAF, PULL SIDE)~~		~~ZER~~
~~2~~	~~EA~~	~~DOOR SWEEP~~	~~39A~~	~~A~~	~~ZER~~
~~1~~	~~EA~~	~~THRESHOLD~~	~~655A-223~~	~~A~~	~~ZER~~
~~2~~	~~EA~~	~~DOOR CONTACT~~	~~679-05HM~~	~~BLK~~	~~SCE~~

~~DOOR POSITION IS MONITORED BY ACCESS CONTROL/SECURITY SYSTEM.~~

HW SET: 02
DOOR NUMBER: (INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING DOORS)
201

3	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	PASSAGE SET	L9010 06A	626	SCH
1	EA	SURFACE CLOSER	4111 AVB EDA MC	689	LCN
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

DOOR POSITION IS MONITORED BY ACCESS CONTROL/SECURITY SYSTEM.

~~**HW SET: 03**~~
~~**DOOR NUMBER: (INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING DOORS)**~~
~~113~~ ~~118~~

~~3~~	~~EA~~	~~HINGE~~	~~5BB1 4.5 X 4.5 NRP~~	~~652~~	~~IVE~~
~~1~~	~~EA~~	~~PUSH PLATE~~	~~8200 4" X 16"~~	~~630~~	~~IVE~~
~~1~~	~~EA~~	~~PULL PLATE~~	~~8305 10" 4" X 16"~~	~~630~~	~~IVE~~
~~1~~	~~EA~~	~~SURFACE CLOSER~~	~~4111 EDA MC~~	~~689~~	~~LCN~~
~~1~~	~~EA~~	~~KICK PLATE~~	~~8400 10" X 2" LDW B-CS~~	~~630~~	~~IVE~~
~~1~~	~~EA~~	~~WALL STOP~~	~~WS406/407CCV~~	~~630~~	~~IVE~~
~~1~~	~~EA~~	~~GASKETING~~	~~488SBK PSA~~	~~BK~~	~~ZER~~

~~**HW SET: 04**~~
~~**DOOR NUMBER: (INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING DOORS)**~~
~~116~~ ~~117~~

~~3~~	~~EA~~	~~HINGE~~	~~5BB1 4.5 X 4.5 NRP~~	~~652~~	~~IVE~~
~~1~~	~~EA~~	~~PUSH PLATE~~	~~8200 4" X 16"~~	~~630~~	~~IVE~~
~~1~~	~~EA~~	~~PULL PLATE~~	~~8305 10" 4" X 16"~~	~~630~~	~~IVE~~
~~1~~	~~EA~~	~~SURFACE CLOSER~~	~~4111 CUSH MC TBWMS~~	~~689~~	~~LCN~~
~~1~~	~~EA~~	~~KICK PLATE~~	~~8400 10" X 2" LDW B-CS~~	~~630~~	~~IVE~~
~~1~~	~~EA~~	~~GASKETING~~	~~488SBK PSA~~	~~BK~~	~~ZER~~

~~**HW SET: 05**~~
~~**DOOR NUMBER: (INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING DOORS)**~~
~~105~~

~~3~~	~~EA~~	~~HINGE~~	~~5BB1 4.5 X 4.5~~	~~652~~	~~IVE~~
~~1~~	~~EA~~	~~PASSAGE SET~~	~~L9010 06A~~	~~626~~	~~SCH~~
~~1~~	~~EA~~	~~KICK PLATE~~	~~8400 10" X 2" LDW B-CS~~	~~630~~	~~IVE~~
~~1~~	~~EA~~	~~WALL STOP~~	~~WS406/407CCV~~	~~630~~	~~IVE~~
~~1~~	~~EA~~	~~GASKETING~~	~~488SBK PSA~~	~~BK~~	~~ZER~~

HW SET: 06
DOOR NUMBER: (INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING DOORS)
114 ~~119~~

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY W/ INDICATOR	L9040 06A L583-363 L283-722	626	SCH
1	EA	SURFACE CLOSER	4011 MC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	COAT AND HAT HOOK	507	626	IVE

HW SET: 06A
DOOR NUMBER: (INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING DOORS)
119

3	**EA**	**HINGE**	**5BB1 4.5 X 4.5**	**652**	**IVE**
1	**EA**	**PRIVACY W/ INDICATOR**	**L9040 06A L583-363 L283-722**	**626**	**SCH**
1	**EA**	**SURFACE CLOSER**	**4011 MC**	**689**	**LCN**
1	**EA**	**KICK PLATE**	**8400 10" X 2" LDW B-CS**	**630**	**IVE**
1	**EA**	**OVERHEAD STOP**	**100 Series**	**630**	**GLYN**
1	**EA**	**GASKETING**	**488SBK PSA**	**BK**	**ZER**
1	**EA**	**COAT AND HAT HOOK**	**507**	**626**	**IVE**

HW SET: 07
DOOR NUMBER: (INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING DOORS)
102 103 ~~104~~ 106

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050L 06A L583-363	626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HW SET: 08
~~**DOOR NUMBER: (INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING DOORS)**~~
~~105A~~

~~3~~	~~EA~~	~~HINGE~~	~~5BB1 4.5 X 4.5 NRP~~	~~630~~	~~IVE~~
~~1~~	~~EA~~	~~DBL CYL DEAD LOCK~~	~~L462L~~	~~626~~	~~SCH~~
~~1~~	~~EA~~	~~MORTISE CYLINDER~~	~~PROVIDED BY UU~~	~~626~~	~~B/O~~
~~1~~	~~EA~~	~~SURFACE CLOSER~~	~~4111 AVB SCUSH MC TBWMS~~	~~689~~	~~LCN~~
~~1~~	~~SET~~	~~GASKETING~~	~~429AA-S~~	~~AA~~	~~ZER~~
~~1~~	~~EA~~	~~DOOR SWEEP~~	~~39A~~	~~A~~	~~ZER~~
~~1~~	~~EA~~	~~THRESHOLD~~	~~655A-223~~	~~A~~	~~ZER~~
~~1~~	~~EA~~	~~DOOR CONTACT~~	~~679-05HM~~	~~BLK~~	~~SCE~~

DOOR POSITION IS MONITORED BY ACCESS CONTROL/SECURITY SYSTEM.

HW SET: 09
DOOR NUMBER: (INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING DOORS)
115

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080L 06A	626	SCH
1	EA	MORTISE CYLINDER	PROVIDED BY UU	626	B/O
~~1~~	~~EA~~	~~WALL STOP~~	~~WS406/407CCV~~	~~630~~	~~IVE~~
1	**EA**	**OVERHEAD STOP**	**100 Series**	**630**	**GLYN**
3	EA	SILENCER	SR64	GRY	IVE

HW SET: A1
DOOR NUMBER: (INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING DOORS)
100/100A

2	EA	CONT. HINGE	112XY EPT		628	IVE
2	EA	POWER TRANSFER	EPT10	✓	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-EO 24 VDC	✓	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP-110MD 24 VDC	✓	626	VON
1	**EA**	**MANUAL FLUSH BOLT**	**FB458** **(TOP OF DOOR 100A ONLY)**		**626**	**606**
1	EA	MORTISE CYLINDER	PROVIDED BY UU (MULLION)		626	B/O
1	EA	RIM CYLINDER	PROVIDED BY OWNER		626	B/O
2	EA	LONG DOOR PULL	9264F 48" 32" STD		630	IVE
2	EA	OH STOP	100S ADJ		630	GLY
2	EA	SURFACE CLOSER	4111 AVB EDAW/62G MC		689	LCN
2	EA	MOUNTING PLATE	4110-18 SRT		689	LCN
2	EA	5TH SCREW SUPPORT	4110-30 SRT		689	LCN
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
1	SET	PERIMETER SEALS	BY DOOR MFG/SUPPLIER			B/O
1	EA	DOOR BELL	BY DIV 26	✓		B/O
1	EA	THRESHOLD	BY DOOR MFG /SUPPLIER			B/O
1	EA	CREDENTIAL READER	BY DIV 28			B/O
2	EA	DOOR CONTACT	679-05HM	✓	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS-FA	✓	LGR	VON

AUTO LOCK/UNLOCK THROUGH ACCESS CONTROL SYSTEM FOR PUSH/PULL OPERATION DURING NORMAL BUSINESS HOURS. REQUEST TO EXIT IS IN EXIT DEVICE PUSH BAR. DOOR POSITION IS MONITORED BY ACCESS CONTROL/SECURITY SYSTEM. CARD IN AFTER HOURS. USER PRESENTS CREDENTIAL, EXIT DEVICE LATCH RETRACTS, USER OPENS DOOR TO ENTER.

HW SET: B1
DOOR NUMBER: (INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING DOORS)
101/101A

2	EA	CONT. HINGE	112XY		628	IVE
2	EA	DUMMY PUSH BAR	350		626	VON
1	**EA**	**MANUAL FLUSH BOLT**	**FB458** **(TOP OF DOOR 101A ONLY)**		**626**	**606**
2	EA	LONG DOOR PULL	9264F 48" 32" STD		630	IVE
2	EA	SURFACE CLOSER	4040XP EDAW/62G MC		689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA SRT		689	LCN
2	EA	5TH SCREW SUPPORT	4040XP-30 SRT		689	LCN
2	EA	WALL STOP	WS406/407CCV		630	IVE
1	SET	PERIMETER SEALS	BY DOOR MFG/SUPPLIER			B/O

END OF SECTION 08 7100

SECTION 08 8000 - GLAZING

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 for windows, doors interior borrowed lites and interior sound glass windows.
2. Glazing sealants and accessories.

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of the following products; 12 inches square.

1. Laminated sound glass.
2. Insulating glass.

C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer glass testing agency and sealant testing agency.

B. Product Certificates: For glass.

C. Product Test Reports: For insulating glass and glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.12 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

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

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass

breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

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

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Guardian Glass; SunGuard.
2. Oldcastle BuildingEnvelope™.
3. Pilkington North America.
4. Viracon, Inc.
5. Vitro Architectural Glass.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E1300.

1. Design Wind Pressures:

    a. As indicated on Drawings.
    b. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.

        1) Wind Design Data: As indicated on Drawings.

2. Design Snow Loads: As indicated on Drawings.
3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated. Rollerwave peak to valley shall be 0.003 or below.

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.

1. Use Basis of Design glass scheduled at the end of this Section, or an equivalent product complying wit requirements, but one if the other listed manufacturers.
2. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
3. Perimeter Spacer: Manufacturer's standard spacer material and construction.
4. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Sealant shall have a VOC content of 250 g/L or less.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant:

1. Acid-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Bostik; Arkema.
2) GE Construction Sealants; Momentive Performance Materials Inc.
3) Pecora Corporation.
4) Sika Corporation.
5) The Dow Chemical Company.
6) Tremco Incorporated.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:

1. Type recommended by sealant or glass manufacturer.

D. Spacers:

1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
2. Type recommended by sealant or glass manufacturer.

E. Edge Blocks:

1. Type recommended by sealant or glass manufacturer.

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

2. Minimum required face and edge clearances.
3. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

A. Glass Type G-1: Clear annealed float glass.

1. Minimum Thickness: 6 mm.

B. Glass Type G-1T: Clear fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.

3.9 INSULATING GLASS SCHEDULE

A. Glass Type G-2: Low-E-coated, clear insulating glass.

1. Basis-of-Design Product: Vitro Architectural Glass; Solarban 70.

2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Annealed float glass.
5. Interspace Content: Argon.
6. Indoor Lite: Annealed float glass.
7. Low-E Coating: Sputtered on second surface.
8. Winter Nighttime U-Factor: 0.28 maximum.
9. Summer Daytime U-Factor: 0.26 maximum.
10. Visible Light Transmittance: 64 percent minimum.
11. Solar Heat Gain Coefficient: 0.27 maximum.

B. Glass Type G-2T: Low-E-coated, clear insulating tempered glass.

1. Basis-of-Design Product: Vitro Architectural Glass; Solarban 70.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Fully tempered float glass.
5. Interspace Content: Argon.
6. Indoor Lite: Fully tempered float glass.
7. Low-E Coating: Sputtered on second surface.
8. Winter Nighttime U-Factor: 0.28 maximum.
9. Summer Daytime U-Factor: 0.26 maximum.
10. Visible Light Transmittance: 64 percent minimum.
11. Solar Heat Gain Coefficient: 0.27 maximum.
12. Safety glazing required.

3.10 SOUND GLASS: DOUBLE-PANED LAMINATED-GLASS SCHEDULE

A. Glass Type G-3: Interior sound glass, with two panes of clear laminated annealed glass.

1. Overall Unit Thickness: As required to accommodate indicated hollow metal frame.
2. Office Side Lite: Clear laminated glass with two plies of annealed float glass.

   a. Minimum Overall Thickness of Lite: 1/2 inch.
   b. Minimum Thickness of Each Glass Ply: 6 mm.
   c. Interlayer Thickness: 0.060 inch.

3. Interspace Content: Air.
4. Plant Side Lite: Clear laminated glass with two plies of annealed float glass.

   a. Minimum Overall Thickness of Lite: 3/4 inch.
   b. Minimum Thickness of Each Glass Ply: 6 mm.
   c. Interlayer Thickness: 0.060 inch.

B. Glass Type G-3T: Interior sound glass, with two panes of clear laminated fully tempered glass.

1. Overall Unit Thickness: As required to accommodate indicated hollow metal frame.
2. Office Side Lite: Clear laminated glass with two plies of fully tempered float glass.

   a. Minimum Overall Thickness of Lite: 1/2 inch.

b. Minimum Thickness of Each Glass Ply: 6 mm.
c. Interlayer Thickness: 0.060 inch.

3. Interspace Content: Air.
4. Plant Side Lite: Clear laminated glass with two plies of fully tempered float glass.

a. Minimum Overall Thickness of Lite: 3/4 inch.
b. Minimum Thickness of Each Glass Ply: 6 mm.
c. Interlayer Thickness: 0.060 inch.

5. Safety glazing required.

END OF SECTION 08 8000

SECTION 09 2216 - 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 05 4000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; and ceiling joists.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Evaluation Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

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 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 on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

C. Horizontal Deflection: For non-composite wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.
2. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized unless otherwise indicated.

B. Studs and Tracks: ASTM C645.

1. Steel Studs and Tracks:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) CEMCO; California Expanded Metal Products Co.
2) ClarkDietrich.
3) MarinoWARE.
4) MBA Building Supplies.
5) MRI Steel Framing, LLC.
6) Phillips Manufacturing Co.
7) SCAFCO Steel Stud Company.
8) Steel Construction Systems.
9) The Steel Network, Inc.

b. Minimum Base-Steel Thickness: 0.0329 inch, unless indicated otherwise.
c. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) CEMCO; California Expanded Metal Products Co.
2) ClarkDietrich.
3) MarinoWARE.
4) MBA Building Supplies.
5) SCAFCO Steel Stud Company.
6) Steel Construction Systems.
7) The Steel Network, Inc.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ClarkDietrich; Backing Plate.
b. MRI Steel Framing, LLC; Flat Strap and Backing Plate.
c. SCAFCO Steel Stud Company; SCAFCO Flat Strap, Blocking, and Backing.
d. Steel Construction Systems; Flat Strap and Blocking.

2. Minimum Base-Steel Thickness: 0.0478 inch.

E. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch-wide flanges.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ClarkDietrich; Spazzer 9200.
b. MRI Steel Framing, LLC; U-Channel Bridging.
c. SCAFCO Steel Stud Company; SCAFCO CRC Cold Rolled Channel.
d. Steel Construction Systems; Steel-Con CRC Cold Rolled Channel.

2. Depth: 1-1/2 inches Insert depth.
3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C645.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ClarkDietrich.
b. MarinoWARE.
c. MBA Building Supplies.
d. MRI Steel Framing, LLC.
e. SCAFCO Steel Stud Company.
f. Steel Construction Systems.

2. Minimum Base-Steel Thickness: 0.0329 inch.
3. Depth: As indicated on Drawings.

G. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
3. 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.

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.

B. Hanger Attachments to Concrete:

1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.

a. Uses: Securing hangers to structure.
b. Type: Torque-controlled, expansion anchor.
c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

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: As indicated on Drawings.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
2. Steel Studs and Tracks: ASTM C645.

a. Minimum Base-Steel Thickness: As indicated on Drawings.
b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch deep.

a. Minimum Base-Steel Thickness: 0.0329 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. Products: Subject to compliance with requirements, provide one of the following:

a. Armstrong World Industries, Inc; Drywall Grid Systems.

b. Rockfon (Rockwool International); 640/660 Drywall Ceiling Suspension.
c. USG Corporation; Drywall Suspension System.

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: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
2. 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.

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: 24 inches o.c. unless otherwise indicated.
2. 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.
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. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

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): 16 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, countersplaying, or other equally effective means.

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. Do not attach hangers to steel roof deck.
5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

E. 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.

F. 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 09 2216

SECTION 09 2900 - GYPSUM BOARD

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 gypsum board.
2. Tile backing panels.

B. Related Requirements:

1. Section 06 1600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 07 9219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
3. Section 09 2216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum board, Type X.
2. Cementitious backer units.
3. Interior trim.
4. Joint treatment materials.
5. Sound-attenuation blankets.

B. Samples for Verification: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

A. Mockups: 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.

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.

1.5 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.

1.6 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 PERFORMANCE REQUIREMENTS

A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 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.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Products: Subject to compliance with requirements, provide one of the following:

a. American Gypsum; 5/8" FireBloc® Type X Gypsum Wallboard.
b. CertainTeed Gypsum; CertainTeed Type X Gypsum Board.
c. National Gypsum Company; Gold Bond® Fire-Shield® Gypsum Board.
d. USG Corporation; USG Imperial® Gypsum Base, Firecode® X or USG Sheetrock® Brand UltraLight Panels Firecode® X.

2. Thickness: 5/8 inch.
3. Long Edges: Tapered.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corporation; FiberCement BackerBoard.
b. Custom Building Products; Wonderboard.
c. FinPan, Inc; EZ Backer.
d. James Hardie Building Products, Inc.; Hardiebacker 500.
e. National Gypsum Company; PermaBase® Cement Board.
f. USG Corporation; DUROCK Cement Board.

2. Thickness: 5/8 inch.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:

a. Cornerbead.
b. U-Bead: J-shaped; exposed short flange does not receive joint compound.
c. Expansion (control) joint.

2.6 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 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 setting-type, sandable topping compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 4 finish, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C1002 unless otherwise 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.

C. 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.

D. Acoustical Sealant: As specified in Section 07 9219 "Acoustical Joint Sealants."

E. Thermal Insulation: As specified in Section 07 2100 "Thermal Insulation."

F. Vapor Retarder: As specified in Section 07 2600 "Vapor Retarders."

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.

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. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. 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.

J. 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: Vertical and horizontal surfaces unless otherwise indicated.

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.
   b. At high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLATION OF TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 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 at locations indicated on Drawings, or if not indicated, according to 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 unless otherwise indicated.

3.6 FINISHING 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 according to ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

a. Primer and its application to surfaces are specified in Section 09 9123 "Interior Painting."

E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 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 09 2900

SECTION 09 3013 - CERAMIC TILING

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. Ceramic mosaic tile.
2. Large format porcelain tile.
3. Waterproof membrane.
4. Metal edge strips.

B. Related Requirements:

1. Section 07 9200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Section 09 2900 "Gypsum Board" for cementitious backer units.

1.3 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. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

C. Face Size: Actual tile size, excluding spacer lugs.

D. Module Size: Actual tile size plus joint width indicated.

1.4 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.

1.5 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:

1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
2. Assembled samples 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 12 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.

1.6 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 and certified porcelain tile.

1.7 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.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.

2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
3. Installer employs only Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers for Project.
4. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of gauged porcelain tile/gauged porcelain tile panels and slabs and large format tile.

B. 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 mockup of floor tile installation.
2. Build mockup of each type of wall tile installation.
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 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.

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.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at 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, 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. Waterproof membrane.
2. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

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. Ceramic Tile Type F3: Factory-mounted unglazed ceramic mosaic floor tile.

1. Basis of Design Product: Provide Item F3 indicated on Finish Legend in the Drawings.

   a. Equivalent Products: Substitutions of comparable products by other manufacturers will be considered prior to bid if the product complies with specified product requirements and is substantially similar in appearance to the Basis of Design product, as judged solely by the Architect.

2. Composition: Porcelain.
3. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
4. Module Size: As indicated on Finish Legend.
5. Thickness: 1/4 inch.
6. Face: Plain with cushion edges.
7. Surface: Slip resistant, with abrasive admixture.
8. Dynamic Coefficient of Friction: Not less than 0.42.
9. Tile Color and Pattern: As indicated on Finish Legend.
10. Grout Color: As indicated on Finish Legend.

B. Ceramic Tile Type W-6: Glazed porcelain tile.

1. Basis of Design Product: Provide Item W6 indicated on Finish Legend in the Drawings.

   a. Equivalent Products: Substitutions of comparable products by other manufacturers will be considered prior to bid if the product complies with specified product requirements and is substantially similar in appearance to the Basis of Design product, as judged solely by the Architect.

2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: As indicated on Finish Legend.
4. Face Size Variation: Rectified.
5. Thickness: 1/4 inch.
6. Face: Plain with square or cushion edges.
7. Tile Color, Glaze, and Pattern: As indicated on Finish Legend.
8. Grout Color: As indicated on Finish Legend.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

   a. Wainscot Cap: Surface bullnose, module size same as adjoining flat tile.

C. Ceramic Tile Type W-6: Porcelain tile.

1. Basis of Design Product: Provide Item W6 indicated on Finish Legend in the Drawings.

   a. Equivalent Products: Substitutions of comparable products by other manufacturers will be considered prior to bid if the product complies with specified product requirements and is substantially similar in appearance to the Basis of Design product, as judged solely by the Architect.

2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: As indicated on Finish Legend.
4. Face Size Variation: Rectified.
5. Thickness: 1/2 inch.
6. Face: Plain with square edges.
7. Tile Color, Glaze, and Pattern: As indicated on Finish Legend.
8. Grout Color: As indicated on Finish Legend.

2.4 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Mapelastic™ HPG or a comparable product by one of the following:

a. Custom Building Products.
b. Laticrete International, Inc.

2.5 SETTING MATERIALS

A. Medium-Bed, Modified Dry-Set Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 5/8 inch.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Ultraflex™ LFT Rapid. or a comparable product by one of the following:

a. Custom Building Products.
b. Laticrete International, Inc.

B. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Ultraflex™ 2, or a comparable product by one of the following:

a. Custom Building Products.
b. Laticrete International, Inc.

2.6 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Kerapoxy IEG CQ, or a comparable product by one of the following:

a. Custom Building Products.
b. Laticrete International, Inc.

B. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; aluminum exposed-edge material.

1. Products: Subject to compliance with requirements, provide the following:

a. Schluter Systems L.P; Schiene.

C. 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.

D. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Bonsal American, an Oldcastle company; Grout Sealer.
b. Custom Building Products; Grout and Tile Sealer.

2.8 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

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.

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 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. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.

2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. 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. Ceramic Mosaic Tile: 1/16 inch.
2. Porcelain Tile: 1/4 inch.

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

I. Metal Edge Strips: Install at exposed edges of monolithic wall tile.

J. Floor Sealer: Apply floor sealer to grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 INSTALLATION OF TILE BACKING PANEL

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 INSTALLATION OF WATERPROOF MEMBRANE

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.

3.6 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.

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 F122; thinset mortar on waterproof membrane.

a. Ceramic Tile Type: floor tile.
b. Thinset Mortar: Improved modified dry-set mortar.
c. Grout: High-performance unsanded grout.

B. Interior Wall Installations, Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units.

a. Ceramic Tile Type: Typical wall tile.
b. Thinset Mortar: Improved modified dry-set mortar.
c. Grout: High-performance unsanded grout.

C. Shower Wall Installations, Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA B412; thinset mortar on cementitious backer units or fiber-cement backer board.

a. Ceramic Tile Type: Wall tile in showers.
b. Thinset Mortar: Improved modified dry-set mortar.
c. Grout: High-performance unsanded grout.

END OF SECTION 09 3013

SECTION 09 5113 - 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 Initial Selection: For components with factory-applied finishes.

C. 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.

D. 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.

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.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed 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.

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.
3. Hold-Down Clips: 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 in location as directed by Architect.
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.

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 01 4000 "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 A according to ASTM E1264.
2. Smoke-Developed Index: 50 or less.

2.3 ACOUSTICAL PANELS ACT1

A. Basis of Design: Item ACT1 on Finish Legend in Drawings (Armstrong Ceiling & Wall Solutions.; Dune).

1. Provide basis of design product or, subject to compliance with requirements, an equivalent product approved by Architect, by one of the following:

a. Certainteed; SAINT-GOBAIN.
b. Rockfon; ROCKWOOL International.
c. USG Corporation.

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.

C. Classification: Provide panels as follows:

1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
2. Pattern: CE (perforated, small holes and lightly textured).

D. Color: White.

E. Ceiling Attenuation Class (CAC): Not less than 35.

F. Light Reflectance (LR): Not less than 0.80.

G. Noise Reduction Coefficient (NRC): Not less than 0.50.

H. Edge/Joint Detail: Square.

I. Thickness: 5/8 inch.

J. Modular Size: 24 by 24 inches.

K. 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.

2.4 ACOUSTICAL PANELS ACT1

A. Basis of Design: Item ACT1 on Finish Legend in Drawings (Armstrong Ceiling & Wall Solutions.; Clean Room VL).

1. Provide basis of design product or, subject to compliance with requirements, an equivalent product approved by Architect, by one of the following:

a. Certainteed; SAINT-GOBAIN.
b. Rockfon; ROCKWOOL International.

c. USG Corporation.

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.

C. Classification: Provide panels as follows:

1. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with vinyl overlay on face.
2. Pattern: E (lightly textured).

D. Color: White.

E. Ceiling Attenuation Class (CAC): Not less than 40.

F. Light Reflectance (LR): Not less than 0.80.

G. Edge/Joint Detail: Square.

H. Thickness: 5/8 inch.

I. Modular Size: 24 by 24 inches.

J. 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.

2.5 METAL SUSPENSION SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Ceiling & Wall Solutions.
2. Certainteed; SAINT-GOBAIN.
3. Rockfon; ROCKWOOL International.
4. USG Corporation.

B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.

C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch-wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.

4. Cap Material: Cold-rolled steel.
5. Cap Finish: Painted white.

2.6 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

B. 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.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Hold-Down Clips: Manufacturer's standard hold-down.

E. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

2.7 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.
2. Certainteed; SAINT-GOBAIN.
3. Rockfon; ROCKWOOL International.
4. USG Corporation.

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 circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

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.

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.
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. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
2. 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.
3. 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.

4. 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: 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.

B. Testing Agency: 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. 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 09 5113

SECTION 09 6513 - 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. Thermoset-rubber base.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 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. 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. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.
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.

B. Where conflicting information is found in the Construction Documents related to products, details or dimensional discrepancies, comply with the most stringent requirements regardless of cost.

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 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 resilient products during the following 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. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

A. Basis of Design: Item B1 on Finish Legend in Drawings (Johnsonite; a Tarkett company, standard cove).

1. Provide basis of design product or, subject to compliance with requirements, an equivalent product approved by Architect by one of the following:

a. Burke Mercer Flooring Products; a division of Burke Industries Inc.
b. Flexco.
c. Johnsonite; a Tarkett company.
d. Roppe Corporation, USA.

B. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:

a. Style B, Cove.

C. Thickness: 0.125 inch.

D. Height: 4 inches.

E. Lengths: Cut lengths 48 inches long.

F. Outside Corners: Job formed or preformed.

G. Inside Corners: Job formed or preformed.

H. Colors: Match Johnsonite; 29 Moonrock.

2.2 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

C. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. Preformed Corners: Install preformed corners before installing straight pieces.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

   a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

   a. Miter corners to minimize open joints.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.

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.

END OF SECTION 09 6513

SECTION 09 6813 - 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.

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.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of edge, transition, and other accessory strips.

9. Transition details to other flooring materials.

C. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

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.
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 or Master II certification level.

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. Build mockups at locations and in sizes shown on Drawings, or if not shown, in location and size as directed by Architect.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. 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. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where 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.
c. Excess static discharge.
d. Loss of tuft-bind strength.
e. Loss of face fiber.
f. Delamination.

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

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Basis of Design Product: Provide Item F1 indicated on Finish Legend in the Drawings (Milliken; Common Thread Point 3).

1. Equivalent Products: Substitutions of comparable products by other manufacturers will be considered prior to bid if the product complies with specified product requirements and is substantially similar in appearance to the Basis of Design product, as judged solely by the Architect.

B. Color: As indicated on Finish Legend in Drawings.

C. Pattern: As indicated on Finish Legend in Drawings.

D. Fiber Content: 100 percent nylon 6, 6.

E. Pile Characteristic: Tufted, textured loop.

F. Pile Thickness: 5.45 mm for finished carpet tile.

G. Backing System: PV-free B2 Hard Back.

H. Size: 50cm by 5cm.

I. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment.

J. Performance Characteristics:

1. Appearance Retention Rating: Heavy use.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

1. Adhesives shall have a VOC content of 50 g/L or less.

C. Metal Edge/Transition Strips: Stainless steel transition strip of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 03 3000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. 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.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

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. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer, and approved by Architect.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

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 09 6813

SECTION 09 7513 - STONE WALL FACING

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. Dimension stone paneling drinking fountain backsplash on interior walls.

B. Related Requirements:

1. Section 07 9200 "Joint Sealants" for sealing joints in stone paneling system with elastomeric sealants.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each stone accessory, and manufactured product.

B. Shop Drawings: Show fabrication and installation details for stone paneling system, including dimensions and profiles of stone units.

1. Show locations and details of joints both within stone paneling system and between stone paneling system and other finish materials.
2. Show locations and details of anchors, including locations of supporting construction.
3. Show direction of veining, grain, or other directional pattern.

C. Delegated-Design Submittal: For stone paneling assembly.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and professional engineer.

B. Material Test Reports:

1. Stone Test Reports: For stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous five years.
2. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For stone paneling to include in maintenance manuals. Include product data for stone-care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone paneling similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: A firm or individual experienced in installing stone paneling similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Sealant Adhesion and Compatibility Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 07 9200 "Joint Sealants," Samples of materials that will contact or affect joint sealants.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.

1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
2. Store stone on wood A-frames or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.

C. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.

D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.10 FIELD CONDITIONS

A. Maintain air and material temperatures to comply with requirements of installation material manufacturers, but not less than 50 deg F during installation and for seven days after completion.

B. Field Measurements: Verify dimensions of construction to receive stone paneling by field measurements before fabrication and indicate measurements on Shop Drawings.

1.11 COORDINATION

A. Coordinate installation of inserts that are to be embedded in concrete or masonry and similar items to be used by stone paneling Installer for anchoring and supporting stone paneling. Furnish setting drawings, templates, and directions for installing such items and deliver to Project site in time for installation.

B. Time delivery and installation of stone paneling to avoid extended on-site storage and to coordinate with work adjacent to stone paneling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design stone paneling system.

B. General: Design stone anchors and anchoring systems according to ASTM C1242.

C. Seismic Performance: Stone paneling system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 GRANITE

A. Material Standard: Comply with ASTM C615/C615M.

A. Basis of Design Product: Provide Item B2 indicated on Finish Legend in the Drawings (Cedar Oniciata M715, polished).

1. Equivalent Products: Substitutions of comparable products by other manufacturers will be considered prior to bid if the product complies with specified product requirements and is substantially similar in appearance to the Basis of Design product, as judged solely by the Architect.

B. Cut stone from one block or contiguous, matched blocks in which natural markings occur.

C. Finish: Polished.

D. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.3 SETTING MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II.

1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Aggregate: ASTM C144.

D. Water: Potable.

2.4 SEALANTS

A. Joint Sealants: Manufacturer's standard sealants that comply with applicable requirements in Section 07 9200 "Joint Sealants" and will not stain the stone they are applied to.

1. Use mildew-resistant joint sealant at plumbing fixtures and for control and expansion joints in toilet rooms and other wet locations.
2. Colors: Provide colors of exposed sealants to match other joints in stone adjoining sealed joints unless otherwise indicated.

2.5 STONE ANCHORS AND ATTACHMENTS

A. Fabricate anchors from stainless steel, ASTM A240/A240M or ASTM A666, Type 304.

1. Fasteners for Stainless-Steel Anchors: Annealed stainless-steel bolts, nuts, and washers; ASTM F593 for bolts and ASTM F594 for nuts, Alloy Group 1.

B. Fabricate dowels from stainless steel, ASTM A276, Type 304.

2.6 STONE ACCESSORIES

A. Temporary Setting Shims: Rigid plastic shims, nonstaining to stone, sized to suit joint thickness.

B. Setting Shims for Direct-Mount Anchoring Systems: Strips of resilient plastic or neoprene, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.

C. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.

D. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Custom Building Products.
b. HMK Stone Care System; ACI International.
c. Hillyard, Inc.
d. Miracle Sealants Company; Rust-Oleum Corp.

2.7 FABRICATION OF STONE, GENERAL

A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.

1. Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically unpleasing, as judged by Architect.

B. Fabricate stone paneling in sizes and shapes required to comply with requirements indicated.

1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."

C. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association.

1. Where items are installed with adhesive or where stone edges are visible in the finished work, make items uniform in thickness and of identical thickness for each type of item; gage back of stone if necessary.
2. Clean sawed backs of stones to remove rust stains and iron particles.
3. Dress joints straight and at right angle to face unless otherwise indicated.
4. Cut and drill sinkages and holes in stone for anchors, supports, and lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.
5. Provide openings, reveals, and similar features as needed to accommodate adjacent work.

D. Finish exposed faces and edges of stone to comply with requirements indicated for finish of each stone type required and to match approved Samples and mockups.

E. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.

1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved Samples[**and mockups**].

2.8 FABRICATION OF STONE PANELING ON WALLS

A. Arrange panels in shop or other suitable space in proposed orientation and sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.

1. Lay out one elevation at a time if approved by Architect.
2. Notify Architect seven days in advance of date and time when layout will be available for viewing.
3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by Architect.
4. Rearrange panels as directed by Architect until layout is approved.
5. Do not trim nonmodular-size units to less than modular size until after Architect's approval of layout, unless otherwise approved by Architect.
6. Mark backs of units and Shop Drawings with sequence numbers based on approved layout. Mark backs of units to indicate orientation of units in completed Work.

B. Nominal Thickness: 1-1/4 inches unless otherwise indicated.

C. Control depth of stone to maintain minimum clearances of 3/4 inch between backs of panels and structural members, fireproofing if any, backup walls, and other work behind stone. Do not back check stone less than 1 inch thick.

D. Cut stone to produce uniform joints 1/8 inch wide and in locations indicated.

2.9 MIXES

A. Mortar, General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.

1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated. Do not use calcium chloride.
2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Discard mortar when it has reached initial set.

B. Setting Mortar: Comply with ASTM C270, Proportion Specification.

1. Type: Type N.
2. Mix Proportions: 1 part portland cement and 2-1/2 to 4 parts lime with aggregate ratio of 2-1/4 to 3 times the volume of cement and lime.

C. Grout: Comply with mixing requirements of referenced ANSI standards and with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive stone paneling and conditions under which stone paneling will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone paneling.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone paneling.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF STONE, GENERAL

A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

B. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping.

C. Contiguous Work: Provide reveals and openings as required to accommodate contiguous work.

D. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.

E. Erect stone units level, plumb, and true with uniform joint widths. Use temporary shims to maintain joint width.

F. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.

1. Sealing of expansion and other joints is specified in Section 07 9200 "Joint Sealants."
2. Keep expansion joints free of plaster, mortar, grout, and other rigid materials.

3.3 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/8 inch in 96 inches, 1/4 inch maximum.

B. Variation from Level: For lintels, sills, chair rails, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, 3/8 inch maximum.

C. Variation of Linear Building Line: For position shown in plan and related portion of walls and partitions, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, 3/8 inch maximum.

D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/8 inch.

E. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/16 inch or one-fourth of nominal joint width, whichever is less.

F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/32-inch difference between planes of adjacent units.

3.4 INSTALLATION OF STONE FACING

A. Set units firmly against setting spots. Locate setting spots at anchors and spaced not more than 18 inches apart across back of unit, but provide no fewer than one setting spot per 2 sq. ft. unless otherwise indicated.

B. Set units on direct-mount anchoring system with anchors securely attached to stone and to backup surfaces. Comply with anchoring recommendations in ASTM C1242.

1. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with sealant for filling kerfs.
2. Set stone supported on clips or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths and to prevent point loading of stone on anchors. Hold shims back from face of stone a distance at least equal to width of joint.

C. Minimum Anchors: Provide anchors at a maximum of 24 inches o.c. around perimeter of stone panels with a minimum of four anchors per panel.

D. Minimum Anchors: Provide a minimum of four anchors per panel up to 12 sq. ft. in face area, plus a minimum of two additional anchors for each additional 8 sq. ft..

E. Grout joints after setting stone.

F. Fill joints with sealant after setting and grouting stone.

3.5 GROUTING JOINTS

A. Grout stone to comply with ANSI A108.10.

1. Use unsanded grout mixture for joints 1/8 inch and narrower.

B. Remove temporary shims before grouting.

C. Tool joints uniformly and smoothly with plastic tool.

3.6 INSTALLATION OF JOINT SEALANT

A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 07 9200 "Joint Sealants." Remove temporary shims before applying sealants.

3.7 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean stone paneling as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.

B. Remove and replace stone paneling of the following description:

1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
2. Defective stone paneling.
3. Defective joints, including misaligned joints.
4. Stone paneling and joints not matching approved Samples and mockups.
5. Stone paneling not complying with other requirements indicated.

C. Replace in a manner that results in stone paneling that matches approved Samples and mockups, complies with other requirements, and shows no evidence of replacement.

D. Clean stone paneling no fewer than six days after completion of grouting and pointing, using clean water and soft rags or stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.

E. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions and recommendations.

3.8 PROTECTION

A. Protect stone surfaces, edges, and corners from construction damage. Use securely fastened untreated wood, plywood, or heavy cardboard to prevent damage.

B. Before inspection for Substantial Completion, remove protective coverings and clean surfaces.

END OF SECTION 09 7513

SECTION 09 9123 - 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 the following interior substrates:

1. Gypsum board.
2. Steel.

1.3 DEFINITIONS

A. MPI Gloss Level 1 (flat): Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. MPI Gloss Level 3 (eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. MPI Gloss Level 5 (semigloss): 35 to 70 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.

B. Submitted products must meet or exceed performance levels of basis of design products listed in each category.

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. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

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 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.8 WARRANTY

A. Use paints that carry a minimum 5-year warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Paint Manufacturers: Subject to compliance with requirements, provide products by Sherwin-Williams; Paint Stores Group.

2.2 PAINT, GENERAL

A. MPI Standards: Unless indicated otherwise, provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Nonflat Paints and Coatings: 50 g/L.
2. Primers, Sealers, and Undercoaters: 100 g/L.
3. Rust-Preventive Coatings: 100 g/L.
4. Zinc-Rich Industrial Maintenance Primers: 100 g/L.

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 coatings 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. 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 Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. 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 3, "Power Tool Cleaning."

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

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.
   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. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply dry-erase coating system with roller covers provided by dry-erase coating manufacturer.

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.

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

A. Steel Substrates: Doors and Frames and other exposed steel.

1. Latex System, Alkyd Primer MPI INT 5.1QQ:

a. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.

1) Sherwin-Williams: Protective & Marine; Kem Kromik Universal Primer - B50WZ1.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) Sherwin-Williams: ProMar 200 Zero VOC; Interior Latex Gloss - B21W12651.

d. Colors: Item W2 on Finish Legend in Drawings

B. Gypsum Board Wall Substrates:

1. High-Performance Architectural Latex System MPI INT 9.2B:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.

1) Sherwin-Williams: ProMar 200 Zero; Interior Latex Primer - B28W02600/B28WQ2600.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) Sherwin-Williams: Pro Industrial; Pre-Catalyzed Epoxy Eg-Shel - K45W01151.

d. Colors: Items W1, W3 and W4 on Finish Legend in Drawings

C. Gypsum Board Ceiling Substrates:

1. Latex over Latex Sealer System MPI INT 9.2A:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.

1) Sherwin-Williams: ProMar 200 Zero; Interior Latex Primer - B28W02600/B28WQ2600.

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) Sherwin-Williams: ProMar 200 Zero VOC; Interior Latex Flat - B30W12651.

d. Colors: Items W1, W3 and W4 on Finish Legend in Drawings

END OF SECTION 09 9123

SECTION 09 9600 - HIGH-PERFORMANCE COATINGS

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 high-performance coating systems on the following substrates:

1. Exterior Substrates:

   a. Galvanized metal doors.
   b. Steel door frames.
   c. Steel rails

2. Interior Substrates:

   a. Steel gratings.

1.3 DEFINITIONS

A. MPI Gloss Level 5 (semi-gloss): 35 to 70 units at 60 degrees, according to ASTM D523.

B. MPI Gloss Level 6 (gloss): 70 to 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.

1. Indicate VOC content.

B. Shop-Applied Primer Verification for Steel: Provide written verification that shop surface preparation and specified shop primer was applied as specified in this Section or in the steel specification sections.

C. Samples for Initial Selection: For each type of topcoat product indicated.

D. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

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.

E. Product List: Cross-reference to coating 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. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating system.

a. 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.

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 coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. PPG Paints.
3. Sherwin-Williams Company (The).

B. Products: Subject to compliance with requirements, provide one of the products listed in the Exterior High-Performance Coating Schedule or Interior High-Performance Coating Schedule for the coating category indicated.

1. Equivalent Products: Substitutions of comparable products by other manufacturers will be considered prior to bid if the product complies with specified product requirements and is the same in quality and appearance to the specified product, as judged by the Architect.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. 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.
3. Products shall be of same manufacturer for each coat in a coating system.

B. VOC Content: For field applications, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Nonflat Paints and Coatings: 100 g/L.
2. Primers, Sealers, and Undercoaters: 100 g/L.
3. Rust-Preventive Coatings: 250 g/L.
4. Zinc-Rich Industrial Maintenance Primers: 340 g/L.

C. Colors: As selected by Architect from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner may engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating 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 coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

C. 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 coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, 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 coating systems indicated.

D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 6/NACE No. 3.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, 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 coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Steel Substrates:

1. Pigmented Polyurethane System:

a. Prime Coat: Primer, rust inhibitive, water based MPI #107.

1) Sherwin-Williams: Pro Industrial: Pro-Cryl Universal Primer - B66W00310.
2) Equal, complying with requirements.

b. Intermediate Coat: Intermediate Coat: Polyurethane, two-component, pigmented, matching topcoat.

c. Topcoat: Waterbased urethane, pigmented, gloss (MPI Gloss Level 6).

1) Sherwin-Williams: Pro Industrial; Waterbased Acrolon 100 Waterbased Urethane - B65-720 Series.
2) Equal, complying with requirements.

B. Galvanized-Metal Substrates:

1. Pigmented Polyurethane over Vinyl Wash Primer:

a. Prime Coat: Primer, vinyl wash.

1) Sherwin-Williams: DTM Wash Primer – B71Y0001.
2) Equal, complying with requirements.

b. Intermediate Coat: Intermediate Coat: Polyurethane, two-component, pigmented, matching topcoat.

c. Topcoat: Waterbased urethane, pigmented, gloss (MPI Gloss Level 6).

1) Sherwin-Williams: Pro Industrial; Waterbased Acrolon 100 Waterbased Urethane - B65-720 Series.
2) Equal, complying with requirements.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Steel Substrates:

1. Epoxy-Modified Latex System:

a. Prime Coat: Primer, rust inhibitive, water based, MPI #107.

1) Sherwin-Williams: Pro Industrial; Pro-Cryl Universal Primer - B66W01310.
2) Equal, complying with requirements.

b. Intermediate Coat: Epoxy-modified latex, interior, gloss matching topcoat.
c. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 3).

1) Sherwin-Williams: Pro Industrial; Waterbased Catalyzed Eggshell Gloss - B73-300 Series.
2) Equal, complying with requirements.

d. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 6).

1) Sherwin-Williams: Pro Industrial; Waterbased Catalyzed Epoxy Gloss - B73-300 Series.
2) Equal, complying with requirements.

END OF SECTION 09 9600

SECTION 10 2600 - WALL PROTECTION

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. Corner guards.

B. Related Requirements:

1. Section 08 7100 "Door Hardware" for metal protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For each type of wall protection showing locations and extent.

1. Include plans, elevations, sections, and attachment details.

C. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

1. Corner Guards: 12 inches long.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall protection product to include in maintenance manuals.

1.6 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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store wall protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
b. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall-protection products from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

2.3 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Babcock-Davis.
b. Construction Specialties, Inc.
c. Inpro Corporation.
d. Korogard Wall Protection Systems; a division of RJF International Corporation.
e. Pawling Corporation.

2. Material: Stainless-steel sheet, Type 304.

a. Thickness: Minimum 0.0625 inch.
b. Finish: Directional satin, No. 4.

3. Wing Size: Nominal 2 by 2 inches.
4. Height: 4 feet.
5. Corner Radius: 1/8 inch.
6. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

2.4 FABRICATION

A. Fabricate wall protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

2.5 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls to which wall protection will be attached for blocking and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with stains or other defects that might be visible in the finished Work.

END OF SECTION 10 2600

SECTION 10 2800 - TOILET, BATH, AND LAUNDRY 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. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Underlavatory guards.
4. Custodial accessories.

1.3 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.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

B. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry; coordinate design of wall construction with Owner-supplied items.

1.8 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.

1.9 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

A. Owner-Furnished Items: Provide blocking, rough framing, nailers, and other items as required to support toilet and bath accessories, including for Owner-furnished items.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Specialties, Inc.
2. Bobrick Washroom Equipment, Inc.
3. Bradley Corporation.
4. GAMCO Specialty Accessories; a division of Bobrick.

B. Grab Bar:

1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel, 0.05 inch thick.

   a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.

3. Outside Diameter: 1-1/2 inches.
4. Configuration and Length: As indicated on Drawings.

C. Mirror Unit:

1. Frame: Stainless-steel channel.

   a. Corners: Welded and ground smooth.

2. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

   a. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.

3. Size: 24 inches wide by 36 inches high.

2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Source Limitations: Obtain public-use shower room accessories from single source from single manufacturer.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Specialties, Inc.
2. Bobrick Washroom Equipment, Inc.
3. Bradley Corporation.
4. GAMCO Specialty Accessories; a division of Bobrick.

C. Grab Bar:

1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel, 0.05 inch thick.

   a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.

3. Outside Diameter: 1-1/2 inches.

4. Configuration and Length: As indicated on Drawings.

D. Robe Hook:

1. Products: Subject to compliance with requirements, provide the following:

a. Bobrick Washroom Equipment, Inc; Surface Mounted Robe Hook B-76717.

2. Description: Double Single-flat-plate unit.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

E. Shower Curtain Rod:

1. Description: 1-1/4-inch OD; fabricated from nominal 0.05-inch- thick stainless steel.
2. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
3. Finish: No. 4 (satin).

F. Shower Curtain:

1. Product: Bezel 01by Standard Textiles.

a. Color: As selected by Architect.

2. Length: Length of track plus the smaller of 30 percent or 30 inches added fullness, Curtain to hang 1/2 inch above floor
3. Material: 100 percent fire-rated polyester.
4. Orientation: Railroaded.
5. Repeat: 2 inches vertical and 2 inches horizontal.
6. Grommets: Corrosion resistant at minimum 6 inches o.c. through top hem.
7. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

2.4 UNDERLAVATORY GUARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Plumberex Specialty Products, Inc.
2. Truebro by IPS Corporation.

B. Underlavatory Guard:

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

2.5 CUSTODIAL ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Specialties, Inc.
2. Bobrick Washroom Equipment, Inc.
3. Bradley Corporation.
4. GAMCO Specialty Accessories; a division of Bobrick.

B. Utility Shelf:

1. Description: With exposed edges turned down not less than 1/2 inch and supported by two triangular brackets welded to shelf underside.
2. Size: 16 inches long by 6 inches deep.
3. Material and Finish: Not less than nominal 0.05-inch- thick stainless steel, No. 4 finish (satin).

C. Mop and Broom Holder:

1. Basis-of-Design Product: Utility Shelf with Mop/Broom Holders and Rag Hooks; by Bobrick Washroom Equipment, Inc.

   a. Model: B-224

2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches.
4. Hooks: Three.
5. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, No. 4 finish (satin).

   a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.
   b. Rod: Approximately 1/4-inch- diameter stainless steel.

2.6 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, 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 and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

D. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

E. Mirrors: ASTM C 1503, 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Stud Walls: Provide stud walls with a 20-gauge minimum thickness strap on solid blocking at accessory locations for mounting.

C. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 2800

SECTION 10 4413 - FIRE PROTECTION 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. Fire-protection cabinets for the following:

a. Portable fire extinguisher.

B. Related Requirements:

1. Section 10 4416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets

1.3 PREINSTALLATION CONFERENCE

A. 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.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.6 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Babcock-Davis.
b. Guardian Fire Equipment, Inc.
c. JL Industries, Inc.; a division of the Activar Construction Products Group.
d. Larsens Manufacturing Company.
e. Nystrom.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Cold-rolled steel sheet Stainless steel sheet.

1. Shelf: Same metal and finish as cabinet.

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. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.

E. Cabinet Trim Material: Steel sheet.

F. Door Material: Steel sheet.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Tempered float glass (clear).

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting lever handle with cam-action latch.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
3. 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 door.
2) Application Process: Silk-screened.
3) Lettering Color: Black.
4) Orientation: Horizontal.

K. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
c. Color: As selected by Architect from manufacturer's full range.

2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Miter corners and grind smooth.
3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.

5. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 height indicated below:

1. Fire-Protection Cabinets: 42 inches above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate 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:

1. Apply vinyl lettering at locations indicated.
2. Apply vinyl lettering on field-painted fire-protection cabinets after painting is complete.

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 10 4413

SECTION 10 4416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Requirements:

1. Section 10 4413 "Fire Protection Cabinets."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 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 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amerex Corporation.
b. Badger Fire Protection.
c. Guardian Fire Equipment, Inc.
d. JL Industries, Inc.; a division of the Activar Construction Products Group.
e. Kidde Residential and Commercial Division.
f. Larsens Manufacturing Company.

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Aluminum Container: UL-rated 4-A: 60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Amerex Corporation.
    b. Badger Fire Protection.
    c. Guardian Fire Equipment, Inc.
    d. JL Industries, Inc.; a division of the Activar Construction Products Group.
    e. Larsens Manufacturing Company.
    f. Nystrom, Inc.

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.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10 4416

SECTION 10 5126 - PLASTIC LOCKERS

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. Heavy-duty polyethylene plastic lockers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of plastic locker.

B. Shop Drawings: For plastic lockers. Include plans, elevations, sections, details, and attachments to other work.

1. Show locker trim and accessories.
2. Include locker identification system and numbering sequence.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For plastic lockers, in manufacturer's standard sizes.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

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. Full-size units of the following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:

a. Locks.
b. Blank identification plates.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver plastic lockers until spaces to receive them are clean, dry, and ready for their installation.

1.10 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.11 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that plastic lockers can be supported and installed as indicated.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of plastic lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.

b. Breakage, corrosion, and delamination under normal conditions.
c. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for Plastic Lockers: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Source Limitations: Obtain plastic lockers and accessories from single source from single manufacturer.

2.2 MATERIALS

A. Solid Plastic Panels: High impact, high density polyethylene (HDPE) formed under high pressure into solid plastic components with homogeneous color throughout, with smooth orange peel finish.

B. Color(s): To be selected from manufacturer’s full color range.

C. Anchors: Material, type, and size required for secure anchorage to each substrate.

1. Provide nonferrous-metal anchors and inserts on inside face of exterior walls for corrosion resistance.

2.3 HEAVY-DUTY PLASTIC LOCKERS

A. Basis of Design Product: Provide TUFFTEC Lockers by Scranton Products, or subject to compliance with requirements, an equivalent product approved by Architect prior to bid by another manufacturer:

B. Dimensions: As indicated

C. Locker Arrangement: Single tier.

D. Body: Assembled by manufacturer’s standard snap lock or slide-together dovetail method, from high-density polyethylene plastic sheet; with edges machined to accept assembly brackets, and with thicknesses as follows:

1. Tops, Bottoms, Backs, and Sides: 3/8-inch thickness.

E. Doors: One piece; fabricated from 1/2-inch- thick high-density polyethylene plastic sheet; with edges machined to accept assembly brackets.

F. Hinges: Assembled into door and locker front; fabricated to swing 180 degrees.

1. Continuous Hinges: Manufacturer's standard, heavy-duty extruded aluminum, full height.

G. Door Handle and Latch: Manufacturer’s standard full-length latch and handle that conceals hasp for pad locks.

1. Provide recessed handles for accessible lockers.

H. Accessories:

1. Assembly Profile: Full height of lockers, PVC plastic, snap fit assembled onto locker sides.

2.4 LOCKS

A. Typical Lockers: Provide hasp for accepting user-provided combination padlocks.

2.5 FABRICATION

A. Fabricate plastic lockers square, rigid, and without warp and with plastic faces flat and free of dents or distortion. Make exposed plastic edges safe to touch and free of sharp edges and burrs. Provide with finish free from scratches or chips.

1. Form body panels, doors, shelves, and accessories from one-piece plastic sheet unless otherwise indicated.
2. Provide fasteners, filler, supports, and closures as required for complete installation.

B. Fabricate each plastic locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Construction: Fabricate plastic lockers using manufacturer’s standard snap-together assembly or slide-together dovetail connections providing solid and secure, anti-racking construction for preassembly at plant prior to shipping.

D. Identification Plates: Manufacturer's standard, etched, embossed, or stamped plates, with numbers and letters at least 3/8 inch high.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install level, plumb, and true; shim as required, using concealed shims.

1. Install plastic lockers in accordance with manufacturer's instructions and approved Shop Drawings.
2. Attach lockers to supporting construction with anchors best suited to substrate conditions.

B. Equipment and Accessories: Fit exposed connections of closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach hooks with at least two fasteners.
2. Identification Plates: Identify plastic lockers with identification indicated on Drawings.

a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

B. Protect plastic lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

C. Touch up marred finishes, or replace plastic lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 5126

SECTION 12 2113 - HORIZONTAL LOUVER BLINDS

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. Horizontal louver blinds with aluminum slats.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting horizontal louver blinds and accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For horizontal louver blinds, include fabrication and installation details.

C. Samples for Verification: For each type and color of horizontal louver blind indicated.

1. Horizontal Louver Blind: Full-size unit, not less than 16 inches wide by 24 inches long.

D. Product Schedule: For horizontal louver blinds. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For horizontal louver blinds with polymer slats that have been tested for compliance with NFPA 701, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.

1.6 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. Horizontal Louver Blinds: Full-size units equal to 5 percent of quantity installed for each size, color, texture, pattern, and gloss indicated, but no fewer than two units.

1.7 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver horizontal louver blinds in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet-work 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 horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain horizontal louver blinds from single source from single manufacturer.

2.2 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

A. Basis of Design: Item BLD1 on Finish Legend (Bali; Classic Blinds, 3000 Series.)

B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radius corners.

1. Width: 1 inch.
2. Thickness: Manufacturer's standard.
3. Spacing: Manufacturer's standard.
4. Finish: Ionized antistatic, dust-repellent, baked polyester finish.

C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrails fully enclose operating mechanisms on three sides.

1. Capacity: One blind(s) per headrail unless otherwise indicated.
2. Ends: Manufacturer's standard.
3. Manual Lift Mechanism:

   a. Lift-Cord Lock: Variable; stops lift cord at user-selected position within blind full operating range.
   b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.

4. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.

   a. Tilt: One-direction, positive stop or lockout limited at an angle of 60 degrees from horizontal, both directions.
   b. Operator: Clear-plastic wand.
   c. Over-Rotation Protection: Manufacturer's detachable operator or slip clutch to prevent over rotation of gear.

5. Manual Lift-Operator and Tilt-Operator Lengths: Manufacturer's standard.

D. Bottom Rail: Formed-steel or extruded-aluminum tube that secures and protects ends of ladders and lift cords and has plastic- or metal-capped ends.

1. Type: Manufacturer's standard.

E. Lift Cords: Manufacturer's standard braided cord.

F. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.

1. Type: Wall.
2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.

G. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.

H. Colors, Textures, Patterns, and Gloss:

1. Slats: White.

2.3 HORIZONTAL LOUVER BLIND FABRICATION

A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped 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. Outside of Jamb Installation: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.

D. Mounting and Intermediate Brackets: Designed for removal and reinstallation of blind without damaging blind and adjacent surfaces, for supporting blind components, and for bracket positions and blind placement indicated.

E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to brackets and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.

F. Color-Coated Finish:

1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.

1. Locate so exterior slat edges are not closer than 1 inch from interior faces of glass and not closer than 1/2 inch from interior faces of glazing frames through full operating ranges of blinds.
2. Install mounting and intermediate brackets to prevent deflection of headrails.
3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.

3.3 ADJUSTING

A. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.

3.4 CLEANING AND PROTECTION

A. Clean horizontal louver blind 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 ensures that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.

C. Replace damaged horizontal louver blinds that cannot be repaired in a manner approved by Architect before time of Substantial Completion.

END OF SECTION 12 2113

SECTION 12 3662 - SOLID SURFACING WINDOWSILLS

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. Solid surface material windowsills.

1.3 ACTION SUBMITTALS

A. Product Data: For windowsill materials.

B. Shop Drawings: For windowsills. Show materials, finishes, and edge profiles.

C. Samples for Verification: For the following products:

1. Windowsill material, 6 inches square.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material windowsills 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 windowsills similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of windowsills.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of windowsills by field measurements before windowsill fabrication is complete.

PART 2 - PRODUCTS

2.1 SOLID SURFACE WINDOWSILL MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Basis of Product: Item M3 on Finish Legend in Drawings (Wilsonart LLC.; Capers 9063GG).
2. Colors and Patterns: As indicated on Finish Legend.

2.2 WINDOWSILL FABRICATION

A. Fabricate windowsills according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom.

B. Configuration:

1. Front: Straight, slightly eased at top.

C. Windowsills: 2cm thick, solid surface material.

D. Joints: Fabricate windowsills without joints.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.

B. Sealant for Windowsills: Comply with applicable requirements in Section 07 9200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material windowsills and conditions under which windowsills will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of windowsills.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install windowsills 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. Secure windowsills to substrate with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match windowsill, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Apply sealant to gaps at walls; comply with Section 07 9200 "Joint Sealants."

END OF SECTION 12 3662

SECTION 12 3663 - 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.

B. Related Requirements:

1. Section 22 4100 "Residential Plumbing Fixtures" 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 Verification: For the following products:

1. Countertop material, 6 inches square.

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.

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. Basis of Design Product: Item M2 as indicated on Finish Legend in the Drawings (Daltile).

a. Provide basis of design product or an equivalent product, subject to compliance with requirements and approved by Architect, by another Manufacturer.
b. Colors and Patterns: As indicated on Finish Legend..

B. 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.

C. Countertops: 3cm thick, quartz agglomerate.

D. Joints: Fabricate countertops without joints.

E. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

   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.
   b. Provide vertical edges, rounded to 3/8-inch radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, 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 07 9200 "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. 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.

D. Apply sealant to gaps at walls; comply with Section 07 9200 "Joint Sealants."

END OF SECTION 12 3663

SECTION 21 0500 – COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Division 23, Section “Common Work Results for Mechanical Systems.”

END OF SECTION 21 0500

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SECTION 21 1000 – AUTOMATIC FIRE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

1.2 SYSTEM DESCRIPTION

A. Design Requirements:

1. It shall be the Contractor's responsibility to design, layout, and size the systems from hydraulic calculations in accordance with the requirements of NFPA 13 - Installation of Sprinkler Systems
2. It shall be the Contractor's responsibility to design the system so that no interference exists between the fire protection system and work of other trades, equipment, and systems designed and installed by others. The latest issues of all architectural, structural, mechanical, and electrical drawings will be furnished for reference to assist the Contractor in preparing the design so as to avoid interference.
3. Submitted calculations shall include flow test data used. Flow test data obtained from local authorities may be used if test has been made within 3 months of project start date. Flow tests performed by this Contractor shall be verified by local authorities.
4. Hydraulic calculations shall be based on 90% of flow test pressure data.
5. The following areas will not be heated. Use dry heads to prevent freezing

    a. Enclosed structural buttresses at the building corners

6. Contractor shall verify hazard classifications for all areas and shall identify them on the plans. Specific hazard areas include:

    a. Phase 3 – Ordinary Hazard Group II – Control Room and Programmer’s Room

B. Performance Requirements:

1. System shall provide coverage for entire building. Connect to existing piping installed above ceiling in two rooms (Control room, Programmer’s Room/Storage)
2. Provide a hydraulically designed wet-pipe sprinkler system to meet requirements of NFPA 13.
3. Interface system with building fire and smoke alarm system.
4. Provide fire department connection (location as noted on the drawings and as required by local authorities).
5. The contractor is responsible for obtaining current flow test data and/or performing the flow test and making all adjustments to the system resulting from the current test data. This data is available from the University of Utah and can be obtained through the general contractor or directly from the University.

6. Sprinkler system design shall be approved by authorities having jurisdiction.

    a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

1.3 SUBMITTALS

A. Refer to Division 01 and Division 21 Section "Common Results for Fire Suppression" for general requirements.

B. Delegated Design Submittal: 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 who shall be considered the Engineer of Record for the Automatic Fire Sprinkler system.
2. Sprinkler shop drawings and calculations shall be sealed and signed by a licensed professional engineer (P.E.) licensed in Utah who shall certify that the sprinkler design and installation meets requirements of the local codes and applicable sections of NFPA. Sprinkler drawings and calculations shall be prepared by an NICET III or IV designer under the direct supervision of the licensed professional engineer in responsible charge.
3. The requirements of the specifications and drawings may require construction beyond that required by Code. Contractor shall provide this system, fully complying with the requirements of these contract documents.

C. Product Data:

1. Piping materials
2. Valves
3. Sprinkler heads
4. Fire protection specialties

D. Shop Drawings: Prepare shop drawings showing layout of fire protection system. Drawings shall reckon with all building components and show routing of piping to clear same. Drawings shall conform to requirements of NFPA 13 "Working Plans" and shall be accurately dimensioned to show proposed location of all fire protection system components. Shop drawings shall be prepared on AutoCAD and the drawing sizes shall be the same as the Engineer's drawings.

E. Quality Assurance/Control Submittals:

1. Drawings and hydraulic calculations shall be submitted to the regulatory agencies having jurisdiction for their approvals. After approvals are obtained, the drawings and hydraulic calculations shall be submitted to the Engineer for review.
2. Submit hydraulic calculation sheets in tabular form conforming to the requirements and recommendations of NFPA 13.

1.4 QUALITY ASSURANCE

A. Qualifications: The system shall be designed and installed by a firm regularly engaged in the design and installation of fire protection systems in accordance with the requirements of the National Fire Protection Association. The firm shall have had a minimum of five years of experience in fire protection system design and installation for projects of similar nature to this project. Engineer may require evidence to support the above qualifications and may reject any proposed installer who cannot show suitable experience.

B. Regulatory Requirements:

1. Refer to Division 21 Section "Common Results for Fire Suppression" for general code, standard and regulatory requirements.
2. The fire protection system shall be in conformance with the requirements of the following regulatory agencies and codes wherever the requirements of such agencies and codes are applicable:

   a. Owner's insurance carrier
   b. Local building department
   c. Local fire department
   d. Local water department

C. Certifications: All materials and equipment used in the installation of the fire protection system shall be as listed in the Underwriters' Laboratories (UL) Fire Protection Equipment Directory, or the Factory Mutual Laboratories Approval Guide and fire protection devices involving fire hazard, and shall be the latest product of the manufacturer.

D. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. High-Pressure Piping System Component: Listed for 250-psig minimum working pressure.

2.2 PIPES AND TUBES

A. Underground: Ductile Iron Pipes: AWWA C151, ductile-iron Class 53 thickness, with iron-alloy C110 threaded and/or flanged fittings, 125 psig minimum working pressure rating. Pipe and fittings shall have AWWA C104 cement-mortar lining and 1 mil bituminous outside coating.

B. Aboveground Upstream of the Backflow Preventer: Refer to Division 22 Section "Plumbing Piping Systems" for piping materials.

C. Aboveground Downstream of the Backflow Preventer – any of the following:

1. Steel Pipe: ASTM A53 or A135 or A795 carbon steel, galvanized where indicated. Schedule 40 for sizes NPS 6 and smaller. Schedule 30 for sizes NPS 8 and larger. Schedule 30 and Schedule 40 "equivalent" or "replacement" having a wall thickness less than Schedule 30 or Schedule 40, respectively, is not allowed.

   a. Acceptable fitting/joint types for use with this pipe:

      1) Threaded
      2) Welded
      3) Cut-groove
      4) Rolled-groove

2. Steel Pipe: ASTM A53 or A135 or A795 carbon steel, galvanized where indicated. Schedule 10 for sizes NPS 5 and smaller, and NFPA 13 specified wall thickness for NPS 6 and larger. Schedule 10 "equivalent" or "replacement" having a wall thickness less than Schedule 10 is not allowed.

   a. Acceptable fitting/joint types for use with this pipe:

      1) Welded
      2) Rolled-groove

3. Copper Tube: ASTM B88, Types L, and M, water tube, drawn temper.

   a. Acceptable fitting types for use with brazed pipe.

4. Soldered Rolled-groove Listed Metallic Pipe and Tubing: Where Engineer of Record has specifically reviewed the application, specially listed steel pipe may be used in accordance with NFPA 13 and the limitations of the listing, including installation instructions.
5. Pipe and fitting/joints not explicitly described above are not acceptable.

2.3 PIPE AND TUBE FITTINGS

A. Cast Iron Threaded Flanges: ANSI B16.1, Class 125, raised ground face, bolt holes spot faced.

B. Ductile Iron and Gray Iron Flanged Fittings: AWWA C110, 125 psig minimum pressure rating, with AWWA C104 cement-mortar lining.

C. Cast Iron Threaded Fittings: ANSI B16.4, Class 125, standard pattern, with threads according to ANSI B1.20.1.

D. Ductile Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, with threads according to ANSI B1.20.1.

E. Malleable Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, with threads according to ANSI B1.20.1.

F. Steel Fittings: ASTM A 234, seamless or welded; ANSI B16.9, buttwelding; or ANSI B16.11, socket-welding type for welded joints.

G. Steel Flanges and Flanged Fittings: Class 150, ANSI B16.5.

H. Grooved-End Fittings for Steel Pipe: UL-listed and FM-approved, ASTM A536, Grade 65-45-12 ductile iron or ASTM A47 Grade 32510 malleable iron, with grooves or shoulders designed to accept grooved couplings.

I. Wrought Copper Fittings: ANSI B16.22, streamlined pattern.

J. Cast Bronze Flanges: ANSI B16.24, Class 150, raised ground face, bolt holes spot faced.

K. Grooved-End Fittings for Copper Tube: UL listed, ASTM B 75, copper tube and ASTM B 584 bronze castings, designed for grooved-end couplings.

2.4 JOINING MATERIALS

A. Flanged Joints for Ductile Iron Pipe and Ductile Iron or Cast Iron Fittings: AWWA C115 ductile iron or gray iron pipe flanges, rubber gaskets, and high-strength steel bolts and nuts.

B. Brazing Filler Metals: AWS A5.8, Classification BCuP or BCuP-4.

C. Couplings for Grooved-End Steel Pipe and Grooved-End Ferrous Fittings: UL 213, AWWA C606, ASTM A536 ductile iron, or ASTM A47 malleable iron housing, with enamel finish. Include synthetic rubber gasket with central-cavity, pressure-responsive design; ASTM A183 carbon steel bolts and nuts; and locking pin, toggle, or logs to secure grooved pipe and fittings.

D. Dry-pipe Systems Couplings: Couplings and gaskets shall be UL listed for dry-pipe service.

E. Couplings for Grooved-End Copper Tube and Grooved-End Copper Fittings: UL 213, ASTM A536 ductile iron or ASTM A47 malleable iron housing, with copper-colored enamel finish. Include synthetic rubber gasket with central-cavity, pressure-responsive design, and ASTM A183 carbon steel bolts and nuts.

2.5 SPECIALTY SPRINKLER FITTINGS

A. Specialty Fittings: UL listed and FM approved, made of steel, ductile iron, or other materials compatible with system materials and applications where used.

B. Sprinkler Alarm Test Fittings: Ductile iron housing with NPS 1-1/2 inlet and outlet, integral test valves, combination orifice and sight glass, and threaded ends.

C. Corrugated (unbraided) Flexible Hose Assembly:

1. The hose assembly shall be FM and UL 1474 listed, corrugated stainless steel flexible hose. The hose assembly shall include a 1-inch NPT inlet nipple for attachment to the sprinkler system branch piping. Include a support bar and brackets that secure the complete flex

sprinkler connection assembly to a medium or heavy-duty commercial suspended ceiling support rail system.

2. Pressure 175 psi, minimum , maximum ambient temperature 225 F .

2.6 GENERAL DUTY VALVES

A. Bronze Two-Piece Ball Valves:

1. Manufacturer and Model:

a. Threaded Ends:

1) Apollo 77-100 Series
2) FNW 420
3) Nibco T-585-70

b. Soldered Ends:

1) Apollo 77-200 Series
2) Nibco S-585-70

c. Grooved Joint:

1) Victaulic Series 721

2. 150 psig SWP, non-shock 600 psig WOG, MSS SP-110, cast bronze, full port, two-piece body design, chrome-plated solid bronze ball with reinforced Teflon seats. Stem packing adjustable for wear with adjusting screw.

B. Butterfly Valves:

1. Flangeless Ferrous Alloy Butterfly Valves

a. Manufacturer and Model:

1) Apollo LD 141
2) Centerline 200
3) NIBCO LC 2000

2. Flangeless, 200 psig CWP Rating through NPS 12, 150 psig CWP Rating NPS 14 and larger, MSSSP 67, cast or ductile iron body, wafer lug type, extended neck, aluminum bronze or nickel plated ductile iron disc, stainless steel shaft, EPDM seat and seal, 10-position lever locking handle through NPS 6, worm gear actuator for NPS 8 and larger valves.
3. Grooved Ferrous Alloy Butterfly Valves

a. Manufacturer and Model:

1) Nibco GD4765
2) Victaulic Series 700

b. Grooved, 200 psig CWP Rating, MSSSP 67, EPDM or polymer coated cast or ductile iron body, extended neck, aluminum bronze or nickel plated ductile iron disc, stainless steel shaft, EPDM seat and seal, 10-position lever locking handle through NPS 6, worm gear actuator for NPS 8 and larger valves.

4. Valves shall be capable for use as isolation valves and be recommended by the manufacturer for dead-end service at the full-rated operating pressure, without the need for downstream blind flanges.

C. Swing Check Valves Bronze, 150 psig SWP, 300 psig non-shock WOG, MSS SP-80, class 150, renewable bronze disc.

1. Manufacturer and Model:

a. Threaded:

1) Nibco T-433
2) Milwaukee 510-T
3) Stockham B-321

b. Soldered:

1) Nibco S-433
2) Milwaukee 1510-T
3) Stockham B-310 TC

2.7 FIRE PROTECTION SERVICE VALVES

A. Gate Valves:

1. NPS 2 and Smaller – UL-262, cast bronze, threaded ends, solid wedge disc, rising stem, OS&Y, screw-in bonnet. Ball valves of same construction may be used.
2. Indicating Valves, NPS 2-1/2 and Smaller: UL 1091; butterfly or ball-type, bronze body with threaded ends; and integral indicating device.
3. NPS 2-1/2 and Larger – UL-262, iron body, bronze trim, flanged ends, solid wedge disc, rising stem, OS&Y, flanged bonnet, 175 psig non shock working pressure.

B. Butterfly Valves: NPS 2-1/2 and Larger – Slow closing, outside indicating, ductile iron body and disk, for grooved piping, with gear operator 175 psig non shock working pressure.

C. Swing Check Valves: Iron body, horizontal or vertical swing check with renewable bronze or stainless steel seat and seat rings, flanged or grooved ends, 175 psig non shock working pressure.

2.8 SPECIALTY VALVES

A. Dry-pipe Valve:

1. Approved Manufacturers: Viking, Tyco, and Reliable.

2. Dry-pipe valve shall be cast iron, differential type, 175 psig working pressure. Valve shall have flanged connections, gasketed hand hole cover, brass-to-neoprene air seat, brass-to-brass water seat, spring-loaded clapper with full open latch. Valve shall be externally resettable without disassembly. Provide all accessories consisting of angle valves, globe valves, pipe nipples and fittings, water and air pressure gauges, accelerator or exhauster when required and maintenance air compressor sized in conformance with NFPA 13.

B. Preaction and Deluge Valves:

1. Approved manufacturers are Viking and Tyco
2. Deluge valve shall separate system water supply from the air filled system piping. Valve shall have flanged connections, gasketed hand hole cover, brass-to-neoprene air seat, brass-to-brass water seat, spring-loaded clapper with full open latch. Provide trim sets consisting of angle valves, globe valves, pipe nipples and fittings, water and air pressure gauges, accelerator or exhauster when required, and air compressor sized in conformance with NFPA 13. Valve shall be externally resettable without disassembly.

C. Pressure-Regulating Valves:

1. Approved Manufacturers: Potter-Roemer, Tyco Fire & Building Products LP, or equivalent.
2. UL 1468, brass or bronze, 400-psig minimum rating. Include female NPS inlet and outlet, adjustable setting feature, and straight or 90-degree-angle pattern design as indicated.
3. Finish: Rough metal.

D. Adjustable Pressure Restricting Valve for Stand Pipe Applications

1. Approved Manufacturers: Potter-Roemer, Tyco Fire & Building Products LP, or equivalent.
2. Cast brass, two-way outlet body equal to Potter-Roemer No. 4085 with male hose thread matching Fire Department requirements and caps and chains.
3. Equip valve with a device to regulate pressure at the outlet to a pressure not exceeding 100 psi under both flow and no-flow conditions.

E. Automatic (Ball Drip) Drain Valves:

1. Standard: UL 1726.
2. Pressure Rating: 175-psig minimum.
3. Type: Automatic draining, ball check.
4. Size: NPS 3/4.
5. End Connections: Threaded.

F. Branch Line Testers:

1. Approved Manufacturers: Elkhart Brass Mfg. Co, Fire-End & Croker corp., Potter-Roemer, or engineer approved equal.
2. Standard: UL 199.
3. Pressure Rating: 175 psig, body Material: brass.
4. Size: Same as connected piping. Inlet: Threaded. Drain Outlet: Threaded and capped, Branch Outlet: Threaded, for sprinkler.

2.9 ALARM DEVICES

A. Supervisory Switches:

1. Approved Manufacturers: System Sensor, Potter, or engineer approved equal.
2. General: UL 346, switch shall be approved for use on the type of valve to be monitored.

B. Water Flow Detector:

1. Approved Manufacturers: System Sensor and Potter.
2. General: Vane type with time-delay and two independent switches with pressure rating of 175 psig.

C. Pressure Switches:

1. Approved Manufacturers: Potter, System Sensor and Tyco Fire.
2. Standard: UL 346. Electrically supervised pressure switch with retard feature.
3. Design Operation: Rising pressure signals water flow.

D. Exterior Alarm:

1. Approved Manufacturers: Farr Alarm and System Sensor.
2. Alarm shall have combination horn and light and be constructed for exterior use.
3. Furnish exterior alarms where required by the local building and fire departments.

E. Interior Alarm:

1. Approved Manufacturers: System Sensor and Potter.
2. Furnish interior alarms where required by the local building and fire departments when the alarm is not part of the work specified in Division 26.

2.10 AUTOMATIC FIRE SPRINKLER HEADS

A. Approved Manufacturers: Viking, Reliable, and Tyco.

B. Sprinkler heads shall have a temperature rating of 170°F in all locations in the plant. Pressure Rating for Automatic Sprinklers: 175-psig minimum. Pressure Rating for High-Pressure Automatic Sprinklers: 250-psig minimum.

C. Sprinkler Heads in Suspended Ceilings: Pendent type, semi-recessed style, chrome plated with bright-white adjustable escutcheon concealed style,.

D. Sprinkler Heads in Exposed Areas: Upright type, standard brass.

E. Sprinkler Heads in Unheated Areas, served from wet pipe system: Dry type, horizontal sidewall or pendent as required. See plans for locations and sizes of unheated structural buttresses at the corners of the building where sprinklers are required

F. Guards: Provide UL 199 sprinkler head guards where the sprinkler deflector is located 7'-0" or less above finished floor, or is otherwise subject to injury. Head guard finish shall match applicable sprinkler head finish requirements.

G. Supply the Owner an extra stock of six sprinklers minimum, three of each type, and a special sprinkler wrench. Heads shall be provided in suitable head cabinets for wall mounting next to fire service entry. Provide any additional heads that may be required by NFPA 13. Provide three extra escutcheon plates of each type installed on the project.

2.11 IDENTIFICATION SIGNS

A. Identification Signs: Provide identification signs at all control, drain, test and alarm valves. Signs shall be of the type, size, and location as required by NFPA.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Entire installation shall be in accordance with approved shop drawings, local codes, and applicable NFPA requirements. When unforeseen job site conditions will not permit piping to be installed as shown on the drawings, necessary changes will be made to accomplish a coordinated system without additional cost to the Owner, even though pipe may have been delivered to the site cut to predetermined lengths. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
2. Locate all valves where readily accessible. All main line valves shall be electrically monitored or secured with a chain and padlock that will lock the valve in an open position.
3. Provide valved test drains as required by NFPA. Pipe test drains, through drain risers where necessary, to the nearest adequate floor drain. Not all sprinkler drains or sprinkler system test drains are shown. Contractor shall be responsible for providing additional sprinkler drains as required. Contractor shall provide additional floor drains and associated waste and vent piping as required at each sprinkler drain location. "
4. Install backflow preventer in water supply in accordance with local water purveyor and/or authority having jurisdiction. Reduced Pressure type required where any toxic material is added to the piping system.
5. Provide galvanized schedule 40 pipe where required by local authority. Provide galvanized fittings and couplings on all galvanized pipe systems.
6. Roll grooved pipe, fittings and couplings shall not be used on dry or preaction systems. \
7. Galvanized pipe shall not be used on wet pipe systems.
8. Use galvanized pipe for dry and pre-action systems, and system drain piping.
9. Make provisions to drain all parts of the piping system.

B. Pipe installations comply with provisions of applicable sections in Division 23 specifications.

C. Automatic Fire Sprinkler Head Installation:

1. Pendent and upright heads shall be installed with the deflectors parallel to the ceiling; clearance between the deflectors and the ceilings, roof decking, roof joints, electric or heating equipment, or other obstructions shall be in accordance with the requirements of NFPA.
2. In those areas where lay-in acoustical tile ceilings are to be installed, install all sprinkler heads in the ceiling tiles centered in both directions
3. Remove all sprinkler head frangible bulb protectors after sprinkler head installation. Protect all recessed and concealed sprinkler heads with factory-supplied caps and covers until ceiling installation is complete.

D. Pressure Gauge Installation:

1. Install pressure gauges at the following locations: each riser or feed main, street side of check valve; at system side of all control valves and at the top of each standpipe. Each gauge connection shall not be less than NPS 1/4 and shall be equipped with a shut-off valve and with provision for draining and install where they are not subject to freezing.
2. The required pressure gauges shall be 3-inch diameter minimum and shall have a maximum limit not less than twice the normal working pressure at the point where installed. They shall be installed to permit removal, and shall be located where they will not be subject to freezing.

E. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13

F. Supervisory Switch Installation: Install supervisory switches on all control valves.

G. Floor Control Valve Installation:

1. Floor control valve shall be a complete assembly consisting of a fire protection service gate or butterfly valve, vane type flow switch with retard, inspectors test and main drain valves.
2. Provide pressure regulating valve on zones where supply pressure exceeds 175 psig
3. Pipe discharge from inspectors test and main drain valves through sight glass and orifice to a drain or a drain riser.
4. This Contractor shall install drain risers to serve floor control valves.

H. Fire Alarm Wiring: All fire alarm and monitor wiring shall be done under the Electrical Division, but the proper operation shall be the fire protection contractor's responsibility.

I. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

J. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.2 FIELD QUALITY CONTROL PIPE TESTING

A. Site Tests/Inspection: The entire fire protection piping system including the underground service piping shall be tested hydrostatically at not less than 200 psig pressure for two hours, or at 50 psig in excess of the maximum static pressure when the maximum static pressure is in excess of 150 psig. The hydrostatic test pressure shall be measured at the low point of the individual system or zone being tested. Refer to NFPA 13, Chapter 24 for additional requirements.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter and NFPA 24.

D. Energize circuits to electrical equipment and devices.

E. Coordinate with fire-alarm tests. Operate as required.

F. Coordinate with fire-pump tests. Operate as required.

G. Verify that equipment hose threads are same as local fire department equipment.

3.3 COMMISSIONING SUPPORT

A. Provide all necessary commission support.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 21 1000

SECTION 22 0500 – COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Division 23, Common Work Results for Mechanical Systems.

END OF SECTION 22 0500

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SECTION 22 0523 – 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 Specifications, apply to this Section.

1.2 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure
2. EPDM: Ethylene-propylene-diene terpolymer rubber
3. PTFE: Polytetrafluoroethylene plastic
4. SWP: Steam working pressure
5. TFE: Tetrafluoroethylene plastic

1.3 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

B. Seismic Control Data: Submit all required information by the Delegated Design Professional in responsible charge of design for Seismic Controls for this project. Where specification section 23 0548, “Wind, Seismic, and Vibration Controls for Mechanical Systems” does not indicate any required seismic controls, no such submittal is required.

1.4 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for valves up to 125 psig and ASME B31.1 valves above 125 psig.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: Valves utilized to supply water for drinking or cooking purposes shall comply with NSF 372 and shall have a weighted average lead content of 0.25% or less.

D. Source Limitations: Obtain valves of a single type through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, 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.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 and smaller with threaded or soldered ends.

C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.

2. Gear Drive: For quarter-turn valves NPS 8 and larger.
3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
5. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

G. Extended Valve Stems: On insulated valves.

H. Valve Ends.

1. Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
2. Solder Joint: With sockets according to ASMEB16.18.

a. Caution: Use solder with melting point below 840°F for angle, check, gate, and globe valves; below 421°F for ball valves.
b. Threaded: With threads according to ASME B1.20.1.

I. Valve Bypass and Drain Connections: MSS SP-45

2.3 BALL VALVES

A. Bronze Two-Piece Ball Valves:

1. Manufacturer and Model:

a. Threaded Ends:

1) Apollo 77CLF
2) Hammond UP8301A
3) Milwaukee UPBA400

b. Soldered Ends:

1) Apollo 77CLF
2) Hammond UP8311A
3) Milwaukee UPBA450

2. 150 psig SWP, non-shock 600 psig WOG, MSS SP-110, cast bronze, full port, two-piece body design, chrome-plated solid bronze ball with reinforced Teflon seats. Stem packing adjustable for wear with adjusting screw, NSF-372.

B. Hose End Valves:

1. Manufacturer and Model:

a. Threaded Ends:

1) Apollo 70LF-100HC Series
2) Nibco T-FP-600A-LF with hose end adaptor and cap

b. Soldered Ends: Apollo 70LF-200HC
c. Grooved Joint

2.4 BUTTERFLY VALVES

A. Flangeless Ferrous Alloy Butterfly Valves:

1. Manufacturer and Model:

a. Apollo 145 LD/WD
b. Centerline 200 NSF 61 and NSF 372
c. Keystone Fig 222
d. NIBCO LD/WD 200

2. Flangeless, 200 psig CWP Rating through NPS 12, 150 psig CWP Rating NPS 14 and larger, MSSSP 67, cast or ductile iron body, wafer lug type, extended neck, aluminum bronze or nickel plated ductile iron disc, stainless steel shaft, EPDM seat and seal, 10-position lever locking handle through NPS 6, worm gear actuator for NPS 8 and larger valves.

B. Valves shall be capable for use as isolation valves and be recommended by manufacturer for dead-end service at the full-rated operating pressure, without the need for downstream blind flanges.

2.5 SILENT SPRING LOADED CHECK VALVE

A. Wafer type, MSS SP-80, Class 125, bronze or coated cast iron body, center guided, aluminum bronze disk, EPDM seats, monel or stainless steel springs.
Manufacturer and Model:

1. Technocheck Techno with FDA-approved seal
2. Val-Matic NSF 372
3. Titan CV 90 DI

2.6 SWING CHECK VALVES

A. Bronze, 150 psig SWP, 300 psig non-shock WOG, MSS SP-80, Class 150, renewable bronze disc.

1. Manufacturer and Model:

a. Threaded:

1) Apollo 161T or 161TLF
2) Milwaukee UP509
3) Stockham LFB-319Y Class 125

b. Soldered:

1) Milwaukee UP1509
2) Stockham LFB-309Y

2.7 RESILIENT SEATED, COATED, SWING CHECK VALVES

A. ANSI/AWWA swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping, 250 psig cold water working pressure.

1. Manufacturer and Model:

a. American AVK, Series 41
b. American Flow Control, Series 2100

2.8 THERMOSTATIC BALANCING VALVES

A. Self-actuating thermostatic recirculation valve shall automatically and continuously maintain the end of each domestic hot water supply line at the specified water temperature. Valve shall regulate the flow of recirculated domestic hot water based on water temperature entering the valve regardless of system operating pressure. When fully closed, the valve shall bypass a minimum flow to maintain dynamic control of the recirculating loop and provide a means for system sanitizing. The valve shall be factory adjustable from 105°F to 140°F as required by project conditions. Thermal actuator shall be spring operated and self-cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits. Thermal actuator shall be rated for a minimum of 200,000 cycles. The valve shall comply with NSF 372.

1. Manufacturer and Model:

a. Circuit Solver model CS
b. Engineer-approved equal

2.9 CHAINWHEEL ACTUATORS

A. Manufacturers:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after 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 opened 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.

3.2 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

1. Shutoff Service:

a. Water:

1) NPS 2 and Smaller: Ball valves
2) NPS 2-1/2 and Larger: Butterfly valves

2. Balancing Service:

a. NPS 2 and Smaller: thermostatic balancing valve

3. Pump Discharge:

a. NPS 1-1/2 and Smaller: Bronze, Class 150, threaded
b. NPS 2 and Larger: Wafer, silent spring check valves

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Domestic Cold Water, Domestic Hot Water, Domestic Hot Water Circulating, Non-potable Water: Use the following types of valves:

1. Ball Valves, NPS 2 and Smaller: Bronze, 2-piece, threaded or soldered
2. Butterfly Valves, NPS 2-1/2 and Larger: Flangeless, ferrous alloy
3. Check Valves:

a. Pump Discharge:

1) NPS 1-1/2 and Smaller: Bronze, Class 150, threaded
2) NPS 2 and Larger: Wafer, silent spring check valves

b. Other than Pump Discharge: Bronze, Class 150

1) NPS 2 and Smaller: Bronze, Class 150, threaded
2) NPS 2-1/2 and Larger: Iron body, Class 250, flanged

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. All equipment and materials shall be installed in accordance with the recommendations of the manufacturer.

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. All valves shall be installed so they are accessible and serviceable. Install valves in position to allow full stem movement.

G. All valves shall be installed so the stem position is not more than 90-degrees from the vertical up position.

H. Install chainwheel operators on valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor elevation.

I. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

J. Isolation valves shall be installed:

1. In piping at each and every piece of equipment
2. In piping whenever said pipe enters or leaves an equipment room
3. At all branch take-offs from mains
4. Where shown on drawings

K. Where butterfly valves are located five pipe diameters or less from an elbow, install the valve with its shaft parallel to the plane of the elbow.

L. Valve identification requirements are in other Division 22 sections.

3.4 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.

B. Soldered Joints: Use ASTM B813, water-flushable, lead-free flux; ASTM B32, lead-free-alloy solder; and ASTM B828 procedure, unless otherwise indicated

3.5 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 22 0523

SECTION 22 0529 – HANGERS & SUPPORTS FOR PLUMBING PIPE AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Division 23 Section "Hangers and Supports for Mechanical Systems."

END OF SECTION 22 0529

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SECTION 22 0548 – SEISMIC AND VIBRATION CONTROLS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Division 23, Section "Seismic and Vibration Controls for Mechanical Systems."

END OF SECTION 22 05 48

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SECTION 22 0700 – 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 Specifications, apply to this Section.

1.2 DEFINITIONS

A. The word "concealed" as used in this section refers to insulation in ceiling plenums, furred spaces, pipe and duct shafts, unheated spaces immediately below roof and crawl spaces. The word "exposed" refers to insulation in other areas.

1.3 SYSTEM DESCRIPTION

A. Systems to be Insulated: Insulate all portions of the following systems, equipment, and accessories, except where noted otherwise or furnished by OEM as part of equipment.

1. Cold Piping Systems:

    a. Domestic cold water
    b. Roof drain bowls, overflow drain bowls, roof drain leaders, overflow roof drain leaders, and storm water drains - horizontal only below roofline inside building, including roof drain bodies and the drop from the drain to the horizontal run
    c. HVAC makeup water piping
    d. Heat-traced piping
    e. Piping and all cold surfaces (valve bodies, etc.) inside equipment
    f. Fittings, valves, strainers, and check valves

2. Hot Piping Systems:

    a. Domestic hot water piping
    b. Domestic hot water circulation piping
    c. Heat-traced piping
    d. Piping inside equipment
    e. Fittings, valves, strainers, and check valves

3. Cold Equipment:

    a. Domestic cold water storage tanks and water softeners

4. Hot Equipment:

    a. Hot water storage tanks and heaters (unless pre-insulated)
    b. Heat exchangers including heat exchanger heads

5. Items that need not be insulated:

    a. Vertical storm water drain piping
    b. Exposed chrome-plated piping to sinks, toilets, etc.
    c. Flexible connectors, air chambers, drain lines from water coolers, and condensate drains
    d. Hot water pump housings
    e. Factory pre-insulated equipment
    f. Domestic hot water expansion tanks

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger
2. Detail attachment and covering of heat tracing inside insulation
3. Detail insulation application at 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
7. Detail application at linkages of control devices
8. Detail field application for each equipment type

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Protect insulation against dirt, water, chemical, or mechanical damage before, during, and after installation. Satisfactorily repair or replace such insulation or covering damaged prior to final acceptance of the work.

B. Packaging: Provide insulation material containers 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 duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork shop drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for the required space 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 PIPE INSULATION

A. Manufacturers:

1. Armstrong World Industries
2. Certainteed Crimpwrap
3. Fibrex Insulations Inc.; Coreplus 1200
4. Knauf Insulation; 1000 Pipe Insulation
5. Manson Insulation Inc.; Alley-K
6. Owens Corning; Fiberglas Pipe Insulation
7. Johns Manville; Micro-Lok

B. Preformed fiberglass conforming to ASHRAE 90.1-2013, ASTM C547, Class I or II, and ASTM C585 with "K" factor of 0.23 Btu-in./h-sf-°F maximum at 75°F mean temperature. See schedule for thickness.

C. Provide factory-applied ASJ/SSL type, ASTM C921, or ASTM C1136, Type I jacket with vapor barrier for cold piping (below ambient), or Type II for hot piping (above ambient). Type I may be

used for both at Contractor's option. Factory-applied flap adhesive (SSL) or conventional staple and tape seal at Contractor's option.

D. Pipe Insulation Thickness Schedule:

		Minimum Insulation Thickness for Pipe Sizes				
	From:		**NPS 1**	**NPS 1-1/2**	**NPS 4**	**Greater than NPS 8**
Piping System Type	**To less than:**	**NPS 1**	**NPS 1-1/2**	**NPS 4**	**NPS 8**	
1. Domestic cold water[1]		1/2”	3/4”	1”	1”	1”
2. Domestic hot water with and including recirculating loop (140°F and less)[1]		1”	1”	1-1/2”	1-1/2”	1-1/2”
3. Domestic hot water, including recirculating loop (greater than 140°F)[1]		1-1/2”	1-1/2”	2”	2”	2”
4. Roof drain bowls and piping[1]		1/2”	1”	1”	1”	1.5”
5. Heat traced outdoor, aboveground domestic water piping		1-1/2”	1-1/2”	2”	2”	2”

Note 1: For piping exposed to outdoor ambient temperatures, increase thickness by 0.5 in.

E. Cover fittings and valves with premolded one-piece PVC-insulated covers. This product is not to be installed in locations where its use is prohibited by local codes.

F. Protect insulation on exterior piping exposed to the weather with weatherproof metal jacket. Provide jacket with 0.016-inch-thick aluminum with laminated vapor barrier. Provide "Z" groove in jacket to assure watertight seal. Seal each joint with snap straps containing permanently plastic sealing compound and secured by 1/2-inch-wide stainless steel bands.

2.2 EQUIPMENT INSULATION

A. Specification "F": 3-inch-thick fiberglass board equal to CSG Group IB600. Provide preformed, flat, rectangular, rigid insulation with a minimum density of 6 lb/ft^3 and a maximum "K" value of 0.22 Btu-in./h-sf-°Fat 75°F mean temperature.

B. Equipment Insulation Schedule:

1. Domestic hot water storage tanks Spec F
2. Heat exchangers Spec F

2.3 ACOUSTIC LAGGING

A. Manufacturer and Model: Kinetics KNM-100ALQ.

B. Provide a barrier constructed of a 0.10-inch-thick barium sulphate loaded limp vinyl sheet bonded to a thin layer of reinforced aluminum foil on one side. Provide barrier with a nominal density of 1

psf and a minimum STC rating of 28. Provide barrier with minimum flammability ratings of 0.0 seconds for flame out and afterglow and 0.2 inches for char length when tested in accordance with Federal Test Std. No. 191-5903. Provide barrier with minimum thermal conductivity “K” value of 0.29 Btu-in./h-sf-°Fand a rated service temperature range of -40°F to 220°F. When tested for Surface Burning Characteristics per ASTM E84, the barrier will have a Flame Spread Index of no more than 10 and a Smoke Development Index of no more than 40.

C. Provide the decoupling layer as a combination of 1-inch fiberglass batting, non-woven porous scrim-coated glass cloth, quilted together in a matrix of 4-inch diamond stitch pattern which encapsulates the glass fibers. Provide type KNM and type KFA decoupling layer by Kinetics. Provide the composite material fabricated to include a nominal 6-inch-wide barrier overlap tab extending beyond the quilted fiber glass to facilitate a leak-tight seal around field joints. Nominal barrier width 54-inch, nominal decoupler width 48-inch.

2.4 JACKETING MATERIAL FOR EQUIPMENT INSULATION

A. Provide pre-sized glass cloth jacketing material, not less than 7.8 oz. per sq. yd., or metal jacket at installer's option, except as otherwise indicated.

2.5 ADHESIVES, MASTICS, AND SEALANTS – LOW VOC

A. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Use sealants that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.6 ADHESIVES

A. Provide materials 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°F.

1. Products: Subject to compliance with requirements, provide the following:

   a. Childers CP-97
   b. Eagle Bridges - Marathon Industries; 290
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Co.; 81-27
   d. Mon-Eco Industries, Inc.; 22-30
   e. Vimasco Corp.; 760

C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide the following:

a. Childers Brand, CP-82
b. Eagle Bridges - Marathon Industries; 225
c. Foster Brand 85-50
d. Mon-Eco Industries, Inc.; 22-25

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide 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

2.7 MASTICS

A. Provide materials compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use at below-ambient services.

1. Products: Subject to compliance with requirements, provide the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Co.; 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°F.
4. Solids Content: ASTM D 1644, 58% by volume and 70% by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide the following:

a. Childers Brand; CP-30
b. Eagle Bridges - Marathon Industries; 501
c. Foster Brand; 30-35
d. Mon-Eco Industries, Inc.; 55-10

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180°F.

4. Solids Content: ASTM D 1644, 44% by volume and 62% by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide the following:

a. Childers Brand; Encacel
b. Eagle Bridges - Marathon Industries; 570
c. Foster Brand; 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°F.
4. Solids Content: ASTM D 1644, 33% by volume and 46% by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Co.; CP-10
b. Eagle Bridges - Marathon Industries; 550
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Co.; 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.
3. Service Temperature Range: Minus 20 to plus 180°F.
4. Solids Content: 60% by volume and 66% by weight.
5. Color: White.

2.8 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products:
2. Products: Subject to compliance with requirements, provide the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Co.; CP-76
b. Eagle Bridges - Marathon Industries; 405
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Co.; 30-45
d. Mon-Eco Industries, Inc.; 44-05
e. Pittsburgh Corning Corp.; Pittseal 444

3. Provide material compatible with insulation materials, jackets, and substrates.

4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300°F.
6. Color: White or gray.

B. FSK and Metal 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 Co.; CP-76
b. Eagle Bridges - Marathon Industries; 405
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Co.; 95-44
d. Mon-Eco Industries, Inc.; 44-05

2. Provide materials compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250°F.
5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, 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 Co.; CP-76

2. Provide materials compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250°F.
5. Color: White.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Install insulation using workmen regularly engaged in this kind of work in strict accordance with the manufacturer's recommendations and recognized industry practices.

3.2 INSTALLATION

A. General:

1. Apply full-length units of insulation on clean, dry surfaces free of foreign matter. Apply only after tests and approvals required by the specifications have been completed.

2. Insulation on cold surfaces must be applied with a continuous, unbroken vapor seal. Supports, anchors, etc., that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.
3. Finish raw edges with finishing cement.

B. Pipe Insulation:

1. Provide continuous pipe insulation through walls and floor openings except where walls and floors are required to be fire-stopped or required to have a fire-resistance rating. Where this occurs, fill the open space remaining between the sleeve and pipe with fire-stop.
2. Butt joints firmly together and smoothly, secure self-sealing jacket laps and joint strips with monel staples at 6-inch o.c. and cover with lap adhesive or factory (SSL) adhesive.
3. Seal ends of cold pipe insulation with a vapor barrier coating at fittings and valves and at intervals of 21 feet on continuous runs of pipe.
4. Insulate cold pipes continuously through hangers. Provide rigid insulation inserts at pipe hangers and supports per Division 22 Section "Hangers and Supports for Plumbing Systems." Butt pipe insulation to the rigid insulation insert. Apply a wet coat of vapor barrier lap cement on butt joints and seal the joints with 3-inch-wide vapor barrier tape or band. Coat staples with heavy coat of brushed on vapor barrier lap cement.

C. Insulation on Fittings and Valves:

1. Where the factory premolded one-piece PVC insulated fitting covers are to be used, apply the proper factory precut insulation to the fitting using two layers for pipe temperatures above 250°F or below 35°F. A single layer of insulation is suitable between 35°F and 250°F. Tuck the ends of the insulation snugly into the throat of the fitting with the edges adjacent to the pipe covering, tufted and tucked in, fully insulating the pipe fitting. Overlap the covers to the adjoining pipe insulation and jackets and seal all cold pipes at seam edges with vapor barrier adhesive. Seal the circumferential edges of covers with pressure sensitive tape. Overlap the tape on the jacket and the cover at least 1 inch.
2. At locations where the PVC covers are prohibited, use as an alternate one of the following methods: one-coat insulation cement, pre-molded fiberglass fitting covers, or mitered segments of pipe insulation. Provide glass fabric embedded in fire-retardant mastic finish. Use vapor barrier mastic for cold piping cold piping.
3. Valves may be insulated with sections of fiberglass pipe insulation complete with all service jacket. Coat raw ends with mastic, and use vapor barrier mastic for cold piping.

D. Pipe Insulation Exposed to Weather: Install metal jacket using waterproof sealant as recommended by manufacturer, and secure with 1/2-inch-wide stainless steel bands. Insulate fittings with preformed or mitered sections of insulation material, covered with metal jacket, sealed, and secured with bands.

E. Hot Equipment Insulation:

1. Cut and miter insulation board to fit the contour of the vessel and tightly butt edges with joints staggered where two or more layers are necessary (due to available thickness of insulation). Secured with 1/2" x 0.015" galvanized steel bands on 12-inch centers or with weld pins or stick clips with washers on 18-inch centers.

2. Over the insulation, tightly stretch 1-inch galvanized wire mesh in place with edges tied together and finish with two coats of insulating cement troweled to a hard finish.

F. Cold Equipment Insulation:

1. Cut and miter insulation board to fit the contour of the vessel and tightly butt edges with joints staggered where two or more layers are necessary (due to available thickness of insulation). Secured with 1/2" x 0.015" galvanized steel bands on 12-inch centers or with weld pins or stick clips with washers on 18-inch centers.
2. Seal joints, breaks, and punctures in facing with fire-retardant vapor barrier adhesive and place 4-inch tape similar to that of the facing material over insulation joints, breaks, and punctures.

G. Acoustic Lagging: Provide acoustical lagging where shown on drawings. Install lagging per manufacturer’s recommendations. Make but joints tight to prevent acoustical leakage and seal with manufacturer’s tape. Where piping is otherwise specified to be insulated, apply over insulation.

H. Other Requirements:

1. Do not insulate manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
2. Provide removable insulation sections to cover parts of equipment that must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames, and accessories.
3. Repair damaged sections of existing plumbing insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation; install new jacket lapping and seal over existing.
4. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

END OF SECTION 22 0700

SECTION 22 1000 – PLUMBING PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

1.2 SUBMITTALS

A. Product Data: Provide submittals on all items furnished under this section including product data on piping materials, fittings, methods, and specialties.

B. Seismic Control Data: Submit all required information by the Delegated Design Professional in responsible charge of design for Seismic Controls for this project. Where specification section 23 0548, "Wind, Seismic, and Vibration Controls for Mechanical Systems" does not indicate any required seismic controls, no such submittal is required.

C. Wind Resistance Data: For all systems and equipment installed outdoors, submit shop drawings indicating the design of the supports and curbs, the attachments to supports and curbs, and the attachment of the support and curbs to the structure, slab, or grade as required to provide resistance to the wind forces identified in Section 23 0548, "Wind, Seismic, and Vibration Controls for Mechanical Systems." Where there is no product of this section installed outdoors, no such submittal is required.

D. Quality Assurance/Control Submittals: Provide test reports required under "Field Quality Control" and "Start-up Services."

E. Operation and Maintenance Data: For equipment and specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PLUMBING PIPING:

A. All components in contact with potable water shall be NSF 61 and NSF 372 certified. Where ever "lead free" occurs, the reference is to these standards.

2.2 DOMESTIC WATER PIPE, TUBE, FITTINGS, AND JOINTS

A. Copper Pipe:

1. Above Grade Pipe: ASTM B88, Type L drawn temper seamless copper tube, NSF-372 and NSF 61 certified.

2. Below Grade Pipe, NPS 3 and smaller: ASTM B88, Type K annealed temper, seamless copper tube.
3. Fittings: ASME B16.22 wrought copper, ASME B16.18 cast copper alloy, or wrought-copper Viega ProPress fittings with EPDM-rubber O-ring seal in each end. NSF-372 and NSF 61 certified.
4. Flanges: ASME B16.24, Class 150 cast bronze flanges with solder joint ends, NSF-372 and SF 61 certified.
5. Unions: ASME B16.18 cast copper alloy, hexagonal stock body with ball-and-socket joint, metal-to-metal seating surfaces, and solder joint and/or threaded ends, NSF-372 and NSF 61 certified.
6. Joints:

    a. Solder Filler: ASTM B 32, Alloy Sn95, Sn94 or E; lead free, NSF 372 and NSF 61 certified.
    b. Brazing Filler Metal: AWS A5.8 BcuP, copper phosphorus or BAg, silver classification.

B. Ductile Iron:

1. Manufacturers:

    a. American Cast Iron Pipe Company
    b. Griffin Pipe Products Company
    c. Pacific States cast iron Pipe Company
    d. United States Pipe and Foundry Company

2. Below Grade Pipe, NPS 4 and Larger: AWWA C151, 250 psig minimum pressure rating ductile iron pipe with mechanical- or push-on-joint, plain spigot end and AWWA C104 cement-mortar lining.
3. Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153 ductile-iron compact pattern mechanical- or push-on fittings with 250 psig minimum pressure rating and AWWA cement-mortar lining.
4. Joints: Include AWWA C111 ductile-iron gland, rubber gasket, and steel bolts with mechanical pipe. Include AWWA C111 rubber gasket with push-on joint pipe.

2.3 REDUCED-PRESSURE BACKFLOW PREVENTER

A. Engineer-Approved manufacturers are Apollo, Febco, and Wilkins.

B. Reduced-Pressure-Principal Backflow Preventer: ASSE 1013, consisting of NRS gate valves, or ball valves for NPS 2 and smaller, on the inlet and outlet and strainer on the inlet. Include test cocks and pressure differential relief valve having ASE A112.12 air-gap fitting located between two positive-seating check valve for continuous pressure application.

C. Provide reduced-pressure backflow preventer of size shown on the drawings.

D. Backflow preventer shall be approved by the Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California and listed on the State of Utah Cross-Connection Regulation Approval list.

E. Backflow preventer shall be provided with an upstream strainer.

2.4 SHOCK ABSORBERS

A. Approved manufacturers are Josam, Precision Plumbing Products, Smith, and Zurn.

B. Shock absorber shall have a factory-sealed, permanently charged compression chamber and internal expansion bellows.

C. Provide shock absorbers in accordance with Plumbing Drainage Institute (PDI) Standard WH 201.

2.5 FREEZE-PROOF WALL HYDRANTS

A. Approved manufacturers are Josam, Smith, Wade, Woodford, and Zurn.

B. Freeze-proof wall hydrant and hose bibb shall include a vacuum breaker.

C. Refer to the drawings for wall thickness on wall hydrants.

2.6 WATER PRESSURE REGULATORS

A. Approved manufacturers are Apollo, Mueller and Watts.

B. Provide type and capacity as indicated on the drawings.

C. Water pressure regulating valves shall be bronze body, rated at 200 psig working pressure, with stainless steel seating ring, and shall conform to ASSE 1003.

2.7 TEMPERING CONTROLLERS

A. Approved manufacturers are Apollo, Lawler, Leonard, Powers, and Symmons.

B. Provide thermostatic water mixing valve of size shown on the drawings.

C. Mixing valve shall be capable of instant compensation for fluctuations in supply pressure and/or temperature of either supply to provide constant mixed water temperature at variable flow rates.

D. Mixing valve shall have automatic safety feature of safe shutdown in the event of failure of either the cold or hot supply.

E. Mixing valve trim shall include spring-loaded check valves, strainers, and screwdriver stops.

F. Valves shall be ASSE certified for their intended use.

2.8 DOMESTIC HOT WATER CIRCULATING PUMP

A. Approved manufacturers are Bell & Gossett, Grundfos, Taco, and Thrush. Pumps shall be certified lead-free and suitable for use in domestic water systems.

B. Provide all bronze or stainless steel in-line circulating pump of size and capacity as listed on the drawings.

C. Pump to have integral thermal overload protection.

D. Provide programmable, seven-day time clock with two cycles per day for seven days. Coordinate wiring with Division 26.

2.9 EXPANSION TANK

A. Acceptable manufacturers are Bell & Gossett, Apollo, Amtrol, Armstrong, Taco, and Watts.

B. Diaphragm Type Expansion Tanks: Provide pre-charged hydropneumatic steel expansion tank of the size and capacity shown on the drawings. ASME-rated for [125 psig] [150 psig] working pressure.

2.10 INTERIOR SANITARY SEWER PIPE, FITTINGS, AND JOINTS

A. Above Grade Cast Iron Gravity Waste and Vent Pipe and Fittings:

1. Manufacturers:

   a. AB&I Foundry
   b. Charlotte Pipe and Foundry
   c. Tyler Pipe Company

2. NPS 15 and Smaller:

   a. Pipe: ASTM A 888 and CISPI 301 hubless cast iron pipe and be listed by NSF International.
   b. Fittings: ASTM A-888 and CISPI 301, hubless fittings. Couplings, both at horizontal and vertical joints, shall be clamped and restrained where required and in accordance with CISPI 310-12.

3. NPS 16 and Larger:

   a. Pipe: ASTM A 74 service weight hub and spigot cast iron pipe.
   b. ASTM A 74 cast iron hub and spigot fittings.

B. Above Grade Pressure Waste Pipe:

1. Manufacturers:

   a. American
   b. McWayne Ductile
   c. US Pipe

2. Push-on-Joint Ductile-Iron Piping:

   a. Pipe: AWWA C151.
   b. Standard Fittings: AWWA C110, ductile or gray iron
   c. Compact Fittings: AWWA C153
   d. Gaskets: AWWA C111, rubber, of shape matching pipe and fittings

3. Mechanical-Joint Ductile-Iron Piping:

   a. Pipe: AWWA C151, with bolt holes in bell
   b. Standard Fittings: AWWA C110, ductile or gray iron, with bolt holes in bell
   c. Compact Fittings: AWWA C153, with bolt holes in bells
   d. Glands: Cast or ductile iron; with bolt holes and high-strength, cast iron or high-strength, low-alloy steel bolts and nuts
   e. Gaskets: AWWA C111, rubber, of shape matching pipe, fittings, and glands

C. Below Grade Gravity Waste and Vent Pipe:

1. Solid-wall PVC Pipe and Fittings:

   a. Manufacturers:

      1) Charlotte Pipe and Foundry
      2) Harvel Plastics
      3) Macon Plastics
      4) National Pipe and Plastics, Inc.
      5) North American Pipe Corporation
      6) Spears Manufacturing

   b. Pipe: ASTM D 1785 & ASTM D 2665, drain, waste, and vent, Schedule 40, NSF-14.
   c. Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

2. Cast Iron Pipe and Fittings:

   a. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.
   b. Manufacturers:

      1) AB&I Foundry
      2) Charlotte Pipe and Foundry
      3) Tyler Pipe Company

c. NPS 10 and Smaller:

1) Pipe: ASTM A 888 and CISPI 301hubless cast iron pipe
2) Fittings: ASTM A-888 and CISPI 301, hubless fittings.

d. NPS 12 and Larger:

1) Pipe: ASTM A 74 service weight hub and spigot cast iron pipe.
2) ASTM A 74 cast iron hub and spigot fittings.

D. Below Grade Pressure Waste Pipe:

1. Manufacturers:

a. American
b. McWayne Ductile
c. US Pipe

2. Push-on-Joint Ductile Iron Piping:

a. Pipe: AWWA C151.
b. Standard Fittings: AWWA C110, ductile or gray iron.
c. Compact Fittings: AWWA C153.
d. Gaskets: AWWA C111, rubber, of shape matching pipe and fittings.

3. Mechanical-Joint Ductile Iron Piping:

a. Pipe: AWWA C151, with bolt holes in bell.
b. Standard Fittings: AWWA C110, ductile or gray iron, with bolt holes in bell.
c. Compact Fittings: AWWA C153, with bolt holes in bells.
d. Glands: Cast or ductile iron; with bolt holes and high-strength, cast iron or high-strength, low-alloy steel bolts and nuts.
e. Gaskets: AWWA C111, rubber, of shape matching pipe, fittings, and glands.

E. Joining Methods:

1. Hubless cast iron pipe joint coupling clamps and shields shall be heavy duty and fabricated from Type 304 stainless steel. Clamps shall be Husky 2000, Mission Heavyweight, or Clamp-All 125. Sealing sleeves shall conform to ASTM C 1540 requirements.
2. Hub and spigot gaskets shall meet ASTM C 564.

a. Solder Filler: ASTM B 32, Alloy Sn95, Sn94 or E; lead free.
b. Brazing Filler Metal: AWS A5.8 BcuP, copper phosphorus or BAg, silver classification.

3. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.11 FLOOR DRAINS

A. Approved manufacturers are Josam, Smith, Zurn, Wade, and Watts.

B. Provide floor drains in accordance with the schedule shown on the drawings.

C. Provide a deep seal trap for each floor drain unless otherwise specified.

D. Provide flashing clamping devices for all drains located in slabs above ground.

2.12 TRAP PRIMER

A. Approved manufacturers are PPI, Josam, Smith, and Zurn.

B. Pressure actuated trap primers shall be all bronze or corrosion-resistant brass, vacuum breaker. The valve shall be activated by a drop in building water pressure. Trap primer shall conform to ASSE 1018.

C. Solenoid actuated trap primers shall include atmospheric vacuum breaker, pre-set 24-hour clock, manual override switch,, solenoid valve, 4 to 30 outlet water distribution manifold.

D. Waterless Trap Protection:

1. Inline floor drain trap seals shall be ASSE 1072 approved.
2. Sure Seal or Engineer-approved equal.

2.13 TRAPS

A. Provide traps for each plumbing fixture, floor drain, and other equipment requiring connection to the sanitary sewer system. Place each trap as near to the fixture outlet as practical. Trap material and type of connections shall be compatible with the connecting drainage system and be suitable for the intended application.

2.14 CLEANOUTS AND CLEANOUT ACCESS COVERS

A. Approved manufacturers are Josam, Smith, Zurn, and Wade.

B. Locations:

1. Rough-In Piping: Josam 58900, coated cast iron, ferrule and taper ABS plug with outlet type to match piping system.
2. Tile or Asphalt Floors: Josam 55000 coated cast iron, recessed top, floor cleanout, internal gasketed taper thread ABS plug, and adjustable housing.
3. Carpet Areas: Josam 55000, coated cast iron, adjustable collar with rolled thread and ABS countersunk plug, and scoriated secure round nikaloy cover.

4. Concrete Floors Without Finish in Mechanical Rooms and Garages: Josam 57000 less top with Josam, coated cast iron, internal gasketed, taper thread ABS plug, and adjustable housing with heavy-duty scoriated loose-set round cast iron tractor cover.
5. Exterior: Josam 55000-VP-22, coated cast iron, internal gasketed, taper ABS plug, and adjustable housing with heavy-duty scoriated loose-set round cast iron tractor cover. Spigot or NO-HUB connection.
6. Wall: Josam 58910, round stainless steel smooth wall access cover, center screw, coated cast iron cleanout ferrule with spigot connection, and recessed thread ABS plug.

2.15 VENT CAPS

A. Approved manufacturers are Josam, Smith, Wade, and Zurn.

B. Provide cast iron, vandal proof, hooded vent caps for all vent terminations. Vent cap shall be held in place with recessed allen head set screws.

2.16 INTERIOR STORM DRAINAGE PIPE, FITTINGS, AND JOINTS

A. Above Grade Cast Iron Gravity Storm Drainage Pipe and Fittings:

1. Manufacturers:

   a. A B & I Foundry
   b. Charlotte Pipe and Foundry
   c. Tyler Pipe Company

2. NPS 15 and Smaller:

   a. Pipe: ASTM A 888 and CISPI 301 hubless cast iron pipe
   b. Fittings: ASTM A-888 and CISPI 301, hubless fittings. Couplings, both at horizontal and vertical joints, shall be clamped and restrained where required and in accordance with CISPI 310-11 and the CISPI Cast Iron Soil Pipe and Fitting Handbook.

3. NPS 12 and Larger:

   a. Pipe: ASTM A 74 service weight hub and spigot cast iron pipe.
   b. ASTM A 74 cast iron hub and spigot fittings.

B. Above Grade Pressure Storm Drainage Pipe:

1. Manufacturers:

   a. American
   b. McWayne Ductile
   c. US Pipe

2. Push-on-Joint Ductile-Iron Piping:

    a. Pipe: AWWA C151.
    b. Standard Fittings: AWWA C110, ductile or gray iron.
    c. Compact Fittings: AWWA C153.
    d. Gaskets: AWWA C111, rubber, of shape matching pipe and fittings.

3. Mechanical-Joint Ductile-Iron Piping:

    a. Pipe: AWWA C151, with bolt holes in bell.
    b. Standard Fittings: AWWA C110, ductile or gray iron, with bolt holes in bell.
    c. Compact Fittings: AWWA C153, with bolt holes in bells.
    d. Glands: Cast or ductile iron; with bolt holes and high-strength, cast iron or high-strength, low-alloy steel bolts and nuts.
    e. Gaskets: AWWA C111, rubber, of shape matching pipe, fittings, and glands.

C. Below Grade Gravity Storm Drainage Pipe:

1. Solid-wall PVC Pipe and Fittings

    a. Manufacturers

        1) Charlotte Pipe and Foundry
        2) Harvel Plastics
        3) Macon Plastics
        4) National Pipe and Plastics, Inc.
        5) North American Pipe Corporation
        6) Spears Manufacturing.

    b. Pipe: ASTM D 1785 & ASTM D 2665, drain, waste, and vent, Schedule 40, NSF-14.
    c. Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

2. Cast Iron Pipe and Fittings

    a. Manufacturers:

        1) A B & I Foundry
        2) Charlotte Pipe and Foundry
        3) Tyler Pipe Company

    b. NPS 10 and Smaller:

        1) Pipe: ASTM A 888 and CISPI 301 hubless cast iron pipe
        2) Fittings: ASTM A-888 and CISPI 301, hubless fittings

    c. NPS 12 and Larger:

        1) Pipe: ASTM A 74 service weight hub and spigot cast iron pipe
        2) ASTM A 74 cast iron hub and spigot fittings

D. Below Grade Pressure Storm Drainage Pipe:

1. Manufacturers:

   a. American
   b. McWayne Ductile
   c. US Pipe

2. Push-on-Joint Ductile Iron Piping:

   a. Pipe: AWWA C151.
   b. Standard Fittings: AWWA C110, ductile or gray iron.
   c. Compact Fittings: AWWA C153.
   d. Gaskets: AWWA C111, rubber, of shape matching pipe and fittings.

3. Mechanical-Joint Ductile-Iron Piping:

   a. Pipe: AWWA C151, with bolt holes in bell.
   b. Standard Fittings: AWWA C110, ductile or gray iron, with bolt holes in bell.
   c. Compact Fittings: AWWA C153, with bolt holes in bells.
   d. Glands: Cast or ductile iron; with bolt holes and high-strength, cast iron or high-strength, low-alloy steel bolts and nuts.
   e. Gaskets: AWWA C111, rubber, of shape matching pipe, fittings, and glands.

E. Joining Methods:

1. Hubless cast iron pipe joint coupling clamps and shields shall be heavy duty and fabricated from Type 304 stainless steel. Clamps shall be Husky 2000, Mission Heavyweight, or Clamp-All 125. Sealing sleeves shall conform to ASTM A 1277ASTM C 1540 requirements.
2. Hub and spigot gaskets shall meet ASTM C 564.
   Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to

   a. PVC solvent cement used on any portion of below grade pipe extending onto building envelope shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   b. Adhesive primer used on any portion of below grade pipe extending onto building envelope shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.17 ROOF DRAINS

A. Approved manufacturers are Josam, Smith, Zurn, Wade, and Watts.

B. Provide roof drains in accordance with the schedule shown on the drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. General:

1. Verify existing grades, inverts, utilities, obstacles, and topographical conditions prior to installation.
2. Examine walls, floors, roofs, and plumbing chases for suitable conditions where piping and specialties are to be installed.
3. Do not proceed until unsatisfactory conditions have been corrected.

B. Domestic Water Service: Connect into the existing water piping at water entry installed in prior phase, as shown on the drawings. Coordinate with the Owner for shutdown of existing water service.

C. Sanitary Sewer: Connect into the existing sanitary sewer as shown on the drawings. Coordinate with Owner for shutdown of existing water service.

D. Storm Sewer: Connect into the existing storm sewer as shown on the drawings.

3.2 INSTALLATION

A. General:

1. Provide bedding, anchors, thrust restrains/anchors, and restraints as appropriate and in accordance with manufacturer's recommendations based on type of pipe, fittings, joints, and bury depth using final finished grading as the basis. All drain pipes (sanitary and storm) over 4 inches shall be provided with restraints at all changes of direction and all changes of diameter greater than two pipe sizes. Braces, blocks, rodding and other suitable methods as specified by the coupling manufacturer shall be utilized.
2. Examine rough-in requirements for plumbing fixtures and other equipment having to verify actual locations of piping connections prior to installation.
3. Examine walls, floors, roofs, and plumbing chases for suitable conditions where piping and specialties are to be installed.
4. Piping shall be run true, plumb, and straight, with all restraints adjusted to carry their proportional load and locked to prevent pipe "wag," misalignment, movement, shear, or sagging.
5. Use fittings for all changes in direction and all branch connections.
6. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted unless expressly indicated.
7. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications. Piping hanger spacing and supports shall be per Code requirements (minimum) , or per Division 23 Section "Hangers and Supports for Mechanical Piping and Equipment," whichever is more stringent.
8. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors unless indicated to be exposed to view.

9. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Allow sufficient space above removable ceiling panels to allow for panel removal.
10. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals.
11. Fire Barrier Penetrations: Where pipes pass through fire-rated walls partitions, ceilings, and floors, maintain the fire-rated integrity. Use fire-stop caulking materials at all fire-rated wall penetrations.
12. Provide for pipe expansion and seismic braces as required by the contract documents and/or jurisdictional authority.
13. All copper tube and fitting shall be reamed and buffed prior to soldering or brazing.
14. The use of solder containing lead is prohibited.
15. Refer and conform to the “Copper Development Association” instructions for proper preparation and actual installation practice for all soldered and brazed joints.
16. Provide 10 mil PVC tape (Scotchwrap No. 50 or equal) for all piping and fittings that are enclosed in concrete or masonry walls.

B. Domestic Water Service: Water service shall be laid at least 1'-0" below frost line.

C. Sanitary Waste and Vent Piping and Storm Drainage Piping:

1. Install building drain and storm sewer with not less than below frost level and to match existing invert elevation.
2. Make changes in direction for drainage piping using appropriate 45-degree wyes, half-wyes, or long sweep quarter, sixth, eighth, or sixteenth bends. Sanitary tees or short quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn tees where two fixtures are installed back-to-back and have a common drain.
3. Cast Iron Soil Pipe: Make compression joints and hubless joints in accordance with the recommendations in the CISPI Cast Iron Soil Pipe and Fittings Handbook, Chapter IV.
4. Underground PVC Pipe: Install in accordance with ASTM D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
5. Hubless cast iron pipe couplings shall be torqued per manufacturer recommendations.
6. Terminate all vents at 18"(minimum) above roof vent caps.
7. Minimum roof drainage slope is 1/8 inch per foot.

D. Reduced-Pressure Backflow Preventer:

1. Locate the valve where it will be visible and accessible for maintenance and at such location that dripping or discharge of water from relief vent will not create a nuisance or damage to finished surfaces.
2. Provide funnel assembly with backflow preventer. Hang and anchor funnel and drain piping rigid to the drain receptor.
3. Install a shutoff valve and strainer upstream and a shutoff valve downstream of the backflow preventer.
4. Provide suitable anchoring device for backflow preventer.

E. Water Pressure Regulator:

1. Provide a water pressure regulator where shown on the drawings.
2. Provide a bronze body wye strainer upstream and full port ball valves and unions upstream and downstream of each regulating valve.
3. Provide a pressure gauge with a gauge cock downstream of each regulating valve. Gauge range at building regulating valves shall be 0 to 200 psig.

F. Shock Absorber: Provide shock absorbers at all solenoid valves, quick-closing valves, and at each plumbing fixture or battery of plumbing fixtures on both hot and cold water supply branches. Size and locations shall be as per manufacturer's recommendations.

G. Freeze-proof Wall Hydrant:

1. Locate wall hydrants such that valve seat is exposed in warm space or warm intersecting wall.
2. Do not try to conceal wall hydrant in exterior wall.

H. Water Meter: Install water meter as required by the local authorities. Provide concrete base support under meter.

I. Domestic Water Booster Pumps:

1. Install on 4-inch-high concrete bases.
2. Install shut off valve on suction and discharge side of domestic water booster pumps.

J. Floor Drains:

1. Set floor drains with the appropriate amount of recess so that the top will be lower than the surrounding floor. Recheck the floor drain setting during concrete finishing phase and adjust the strainer to the proper height.
2. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
3. Position drains so they are accessible and easy to maintain.
4. Provide waterless trap protection at all floor drains except showers, unless otherwise indicated. Mount trap primers in accessible locations, in mechanical rooms, or other approved locations.

K. Cleanouts:

1. Provide cleanouts in locations required by Code and at locations shown on the drawings. Full size for pipe up to 4 inches at the base of all vertical stacks, ends of sewer mains, changes in direction of sewer mains, and in horizontal runs of piping not over 50 feet apart for interior sewers, and not over 100 feet apart for exterior sewers. Install cleanouts so they are accessible by extending them through walls or floors. Install floor and wall cleanout covers for concealed piping.
2. For exterior cleanouts, extend cast iron inspection pipe up to exterior cleanout poured in place in 24" x 24" x 8" concrete block set flush with finished grade.

L. Flashing:

1. Flashing Flanges: Install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes.
2. Vent Flashing Sleeves: Install on stacks passing through roof, secure over stack flashing in accordance with manufacturer's instructions.

M. Grease Interceptor:

1. Install interceptor as recommended by the manufacturer. Provide excavation and backfill. Provide manhole extensions as required to meet grade elevation.
2. Install influent and effluent piping with sleeves through interceptor walls. Grout all joints watertight. Route vent pipes as shown on the drawings.

N. Oil Interceptor:

1. Install interceptor as recommended by the manufacturer. Provide excavation and backfill. Provide manhole extensions as required to meet grade elevation. Slope grade away from access covers.
2. Provide adequate clearance around top access covers to allow for maintenance and removal of coalescing plates.
3. Consult with the roofing applicator and set roof drains at the exact elevation required for proper drainage.
4. Install drain flashing collar or flange so that no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.
5. Position roof drains so that they are accessible and easy to maintain.

3.3 FIELD QUALITY CONTROL

A. General Testing Procedures:

1. All piping systems shall be tested and proven tight prior to concealment. The test shall be witnessed by the Architect/Engineer, plumbing inspector, or the Owner's representative.
2. Isolate fixtures to prevent damage from pressure tests.

B. Domestic Water Pipe Testing:

1. Open and close all system valves at least once while system is pressurized to test valve packing. Tighten as required.
2. Test procedures shall be as follows:

   a. Domestic Hot and Cold Water: 150 psig hydrostatic test. (200 psig on water service when serving a fire line.)
   b. All hydrostatic tests shall be held for a minimum of eight hours without loss of pressure.

C. Drainage Systems Testing Procedure: Drainage systems (including sanitary sewers, sanitary vents, and storm sewers): Test piping systems in accordance with the test procedures required by the applicable Plumbing Code.

D. Perform the following tests and prepare test reports. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly, and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

E. Adjust water pressure regulators, tempering controllers, and domestic water booster pumps to set point and prepare test report.

F. Verify limestone fill in acid neutralization/dilution basins and fill with water to confirm proper drainage.

G. Fill grease/oil separators with water, verify weir levels, and verify proper drainage.

3.4 START-UP SERVICES

A. Engage a factory-authorized service representative to perform start-up service and commissioning support for each submersible pump and elevator sump pump.

1. Complete installation and start-up checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean sump and strainers on suction piping.
4. Verify that pump is rotating in the correct direction.
5. Start motor.
6. Open discharge valve slowly.
7. Measure and record motor amperage.
8. Prepare test report. Include copies of completed test report in O&M Manual.

B. Provide factory-authorized start-up and commissioning support for domestic water booster systems, submersible and other electrically driven equipment. Include completed start-up forms in O&M Manual.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain plumbing equipment and specialties. Video record the training sessions.

3.6 CLEANING

A. Sterilization:

1. Prior to placing the potable water system in operation, but after all testing has been completed, sterilize and flush the entire or sectionalized piping system per code. During this period of time, a pressure of not less than 40 psig shall be maintained on the section being opened and closed several times.

2. Water samples shall be taken and tested by an independent laboratory. The system must be free of all bacteriological contamination. If the system shows any contamination, it shall be re-chlorinated until it is free of bacteriological contamination.

END OF SECTION 22 1000

SECTION 22 3000 – PLUMBING FIXTURES, EQUIPMENT, AND SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

1.2 SUBMITTALS

A. Product Data:

1. Provide submittals on all items furnished under this section.
2. For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. For equipment and tanks required to be ASME rated and stamped; submit product data indicating compliance with the ASME pressure vessel requirements.

B. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

C. Seismic Control Data: Submit all required information by the Delegated Design Professional in responsible charge of design for Seismic Controls for this project. Where specification section 23 05 48, “Wind, Seismic, and Vibration Controls for Mechanical Systems” does not indicate any required seismic controls, no such submittal is required.

D. Operating and Maintenance Manual: Submit operating and maintenance data and parts list for each item of equipment, control and accessory; including "troubleshooting" maintenance guide.

E. Field Quality Control Reports: Submit all test reports specified herein.

F. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements:
   1. Comply with requirements in Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
   2. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1,
   3. ASME Compliance:
      a. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.
      b. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
   4. NSF Standard: Pipe, pipe fittings, joints, valves, faucets, and fixture fittings utilized to supply water for drinking or cooking purposes shall comply with NSF 372 and shall have a weighted average lead content of 0.25% or less.

D. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

E. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

   1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
   2. Plastic Shower Enclosures: ANSI Z124.2.
   3. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
   4. Slip-Resistant Bathing Surfaces: ASTM F 462.
   5. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
   6. Stainless Steel Commercial, Handwash Sinks: NSF 2 construction.
   7. Stainless Steel Residential Sinks: ASME A112.19.3.
   8. Vitreous-China Fixtures: ASME A112.19.2M.
   9. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
   10. Water-Closet, Flushometer Tank Trim: ASSE 1037.

F. 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.
   7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
   8. NSF Potable-Water Materials: NSF 372.
   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.

G. Comply with the following applicable standards and other requirements specified for bathtub 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.

H. Comply with the following applicable standards and other requirements specified for miscellaneous fixtures and fittings:

1. Disposers: ASSE 1008 and UL 430.
2. Dishwasher Air-Gap Fittings: ASSE 1021.
3. Electric Water Coolers: ARI 1010.
4. Flexible Water Connectors: ASME A112.18.6.
5. Floor Drains: ASME A112.6.3.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Hot-Water Dispensers: ASSE 1023 and UL 499.
8. Off-Floor Fixture Supports: ASME A112.6.1M.
9. Pipe Threads: ASME B1.20.1.
10. Plastic Shower Receptors: ANSI Z124.2.
11. Plastic Toilet Seats: ANSI Z124.5.
12. Supply and Drain Protective Shielding Guards: ICC A117.1.

I. Certifications:

1. Gas water heaters shall be AGA certified.
2. Electric water heaters shall be UL listed.
3. Electric Water Coolers shall be UL listed.
4. Water storage tanks shall be ASME-rated and stamped for the working pressure.

1.4 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion:

a. Commercial electric water heater shall have a 5-year warranty.

PART 2 - PRODUCTS

2.1 FIXTURE TRIM

A. Lavatory Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.
b. Chicago Faucet
c. Delta
d. Moen
e. Zurn

2. Description: Style as scheduled on drawings. Individual handles to include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor. Furnish with ASSE 1070 tempering valve where required by code.

a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.

B. Bathtub Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.
b. Chicago Faucets
c. Delta Faucet Company
d. Moen, Inc.

e. Zurn Plumbing Products Group; Commercial Brass Operation

2. Description: Style as scheduled on drawings. Individual handles to include hot- and cold-water indicators. Include tub spout. Coordinate faucet inlets with supplies.

   a. Body Material: Solid brass.
   b. Finish: Polished chrome plate.

C. Bathtub/Shower Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Lawler
   b. Leonard Valve Company
   c. Moen, Inc.
   d. Powers; a Watts Industries Co.
   e. Symmons Industries, Inc.
   f. Zurn Plumbing Products Group; AquaSpec Commercial Faucet Operation

2. Description: Single-handle thermostatic/pressure-balance, ASSE 1016, valve for bathtub and for shower. Include hot- and cold-water indicators; check stops; tub spout; and shower head, arm, and flange. Coordinate faucet inlets with supplies; coordinate outlet with diverter valve.

   a. Body Material: Solid brass.
   b. Finish: Polished chrome plate.
   c. Maximum Flow Rate: 1.5 gal or as otherwise scheduled.
   d. Diverter Valve: Integral with mixing valve.
   e. Mounting: Wall
   f. Bathtub Spout: Chrome-plated brass with diverter.
   g. Anti-scald Device: Integral with mixing valve
   h. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
   i. Backflow protection device for hand-held shower

D. Shower Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Lawler
   b. Leonard Valve Company
   c. Moen, Inc.
   d. Powers; a Watts Industries Co.
   e. Symmons Industries, Inc.
   f. Zurn Plumbing Products Group; AquaSpec Commercial Faucet Operation.

2. Description: Single-handle thermostatic and pressure-balance valve, ASSE 1016. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.

    a. Body Material: Solid brass.
    b. Finish: Polished chrome plate.
    c. Maximum Flow Rate: 1.5 gal or as otherwise scheduled.
    d. Mounting: Concealed.
    e. Backflow Protection Device for Hand-Held Shower:
    f. Anti-scald Device: Integral with mixing valve.
    g. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.

E. Sink Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard Companies, Inc.
    b. Chicago Faucet
    c. Delta
    d. Moen
    e. Zurn

2. Description: Style as scheduled on drawings. Individual handles to include hot and cold water indicators. Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

    a. Body Material: Commercial, solid brass.
    b. Finish: Polished chrome plate.
    c. Maximum Flow Rate: scheduled.
    d. Backflow Protection Device for Side Spray.

F. Flushometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Delany Co.
    b. Hydrotek
    c. Sloan Valve Company
    d. Zurn Plumbing Products Group; Commercial Brass Operation.

2. Description: Style as scheduled on drawings. Include brass body with corrosion-resistant internal components, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
3. Match consumption to fixture requirement.

G. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Bemis Manufacturing Company
   b. Church Seats
   c. Olsonite Corp.
   d. Sperzel
   e. Zurn

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: Check
   e. Class: Commercial
   f. Color: White

H. 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-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

I. Traps, Stops, Supplies, Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard
   b. Brasscraft
   c. Kohler
   d. Zurn

J. Provide trim, supply, and waste connections for plumbing fixtures as scheduled on the drawings or as additionally required for a complete and operational fixture..

K. All exposed trim shall be chrome-plated brass unless otherwise specified in schedule.

2.2 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 division of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation

B. Water-Closet Supports: Description: Combination carrier designed for mounting height of wall-mounting, water-closet-type fixture shown on drawings. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

C. Urinal Supports:

1. Description: Urinal carrier with hanger and bearing plates for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Lavatory Supports:

1. Description: 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.

2.3 SEDIMENT INTERCEPTORS

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

B. Description: Manufactured unit with removable screens or strainer and removable cover; designed to trap and retain waste material.

1. Material: Cast-iron or steel body with acid-resistant lining and coating.

2.4 SHOWER RECEPTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Florestone Products Co., Inc.
2. LASCO Bathware
3. Sterling Plumbing Group, Inc.
1. American Standard Companies, Inc.

B. Description: Solid-surface base for built-up-type shower fixture.

1. Style as scheduled on the drawings.

2.5 DISPOSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. In-Sink-Erator
2. KitchenAid

B. Description: Continuous-feed household food-waste disposer. Include a reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery or stainless steel grinder or shredder; an NPS 1-1/2 outlet; quick-mounting, stainless steel sink flange; anti-splash guard; and combination cover/stopper.

2.6 HOT WATER DISPENSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. In-Sink-Erator; a div. of Emerson Electric Co.
2. KitchenAid

B. Description: Gooseneck spout with lever-handle, flow control, household-type dispenser with instant on-off control; insulated, corrosion-resistant-metal storage tank that is open to atmosphere; electric heating element; chrome-plated faucet or spout; in-line filter; thermostat control for water temperature up to 190°F; and thermal-overload protection. NSF-372 and UL listed.

2.7 FIXTURES

A. Water Closets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard Companies, Inc.
   b. Eljer
   c. Kohler Co.
   d. Zurn

2. Description: Style, mounting, and flush mechanism as scheduled on drawings. Vitreous china body.
3. Consumption: 1.28 gal or as otherwise scheduled.

B. Urinals:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard Companies, Inc.
   b. Eljer
   c. Kohler Co.
   d. Zurn

2. Description: Style, mounting, and flush mechanism as scheduled on drawings. Vitreous china body.
3. Consumption: 0.125 gal or as otherwise scheduled.

C. Lavatories:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard Companies, Inc.
   b. Eljer
   c. Kohler Co.
   d. Zurn

2. Description: Style and mounting as scheduled on drawings. Vitreous china body.

D. Sinks, Stainless Steel:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Bradley Corporation
   b. Elkay Manufacturing Co.
   c. Just Manufacturing Company

2. Description: Style and mounting as scheduled on drawings.

E. Sinks, Cast Iron:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard Companies, Inc.
   b. Kohler Co.
   c. Eljer
   d. Zurn

2. Description: Style and mounting shall be as scheduled on the drawings.

F. Wash Fountains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Acorn Engineering Company
   b. Bradley Corporation

2. Style, arrangement, and material shall be as scheduled on the drawings.

G. Service Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard Companies, Inc.
   b. Kohler Co.
   c. Eljer
   d. Zurn

2. Description: Style as specified on drawings. Trap-standard- and wall-mounting, enameled, cast-iron fixture with roll-rim with plain back and rim guard on front and sides.

H. Service Basins:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Plumbing, L.L.C./Fiat Products
   b. Florestone Products Co., Inc.

2. Description: Flush-to-wall, floor-mounting, precast terrazzo fixture with rim guard.

I. Drinking Fountains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Acorn Engineering Company
   b. Bradley Corporation
   c. Elkay Manufacturing Co.
   d. Halsey Taylor
   e. Haws
   f. Oasis

2. Description: Style and mounting as specified on drawings. Stainless steel, furnish with carrier. NSF-372 listed.

J. Drinking Fountains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard Companies, Inc.
   b. Kohler Co.
   c. Eljer
   d. Zurn

2. Description: Style and mounting as specified on drawings. Vitreous china, furnish with carrier. NSF-372 listed.

K. Electric Water Coolers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Acorn Engineering Co.
   b. Bradley Corporation
   c. Elkay Manufacturing Co.
   d. Halsey Taylor
   e. Haws
   f. Oasis

2. Description: Style and mounting as specified on drawings. Stainless steel, furnish with carrier. NSF-372 and UL listed.

L. Emergency Showers, Eye Washes, and Face Washes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Haws
   b. Speakman
   c. Guardian

d. Acorn
e. Bradley

M. Detention/Institutional-grade Plumbing Fixtures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Engineering Co.
b. Bradley Corporation
c. Willoughby

2.8 ELECTRIC WATER HEATER (COMMERCIAL)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A.O. Smith
2. PVI
3. State

B. Provide the following:

1. The water heater shall be electric with automatic controls including energy cut-off when water temperature is too high. The heater shall be listed by UL
2. The storage capacity and recovery capacity shall be as shown on the drawings.
3. Tank shall be heavy gauge steel rated at 150 psig working pressure with inner lining of glass. There shall be insulation completely around the tank except the bottom. There shall be a hose thread drain valve at bottom of tank and a handhole cleanout.
4. Water heater shall have magnesium anode rod suspended in tank to minimize internal tank corrosion.
5. The water heater shall have a jacket of cold rolled steel with baked-on enamel finish. Jacket shall have provisions for access to all controls and burners.
6. Provide temperature/pressure relief valve with AGA temperature steam rating in excess of the input rating of the water heater.
7. The water heater shall meet ASHRAE 90.1-2007.

2.9 INSTANTANEOUS ELECTRIC WATER HEATER (COMMERCIAL)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chronomite
2. EEMAX

B. Provide the following:

1. The water heater shall be electric with automatic controls including energy cut-off when water temperature is too high. The heater shall be listed by UL.
2. The instantaneous heating capacity shall be as shown on the drawings.
3. Heater shall include the following features ; adjustable temperature range between 100°F and 140°F, flow switch activates heater only on demand, microprocessing temperature control, field serviceable element-replaceable cartridge element with one year warranty, leak failure warranty for five years, high temperature limit switch with reset button.
4. The water heater shall meet ASHRAE 90.1-2007 standard for heat loss.

2.10 WATER HEATER ACCESSORIES

A. Piping-Type Heat Traps: Field Fabricated piping arrangement according to ASHRAE 90.1-2007.

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. Plumbing Fixtures and Trim:

1. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
2. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

    a. Use carrier supports with waste fitting and seal for back-outlet fixtures.
    b. Use carrier supports without waste fitting for fixtures with tubular waste piping.
    c. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

3. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
4. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
5. Install wall-mounting fixtures with tubular waste piping attached to supports.
6. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
7. Install counter-mounting fixtures in and attached to casework.

8. Install fixtures level and plumb according to roughing-in drawings.
9. 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.

    a. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division22 Section "General Duty Valves for Plumbing Piping."

10. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
11. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
12. 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.
13. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
14. Install toilet seats on water closets.
15. 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.
16. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
17. 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.
18. Install shower flow-control fittings with specified maximum flow rates in shower arms.
19. Install traps on fixture outlets.

    Exception: Omit trap on fixtures with integral traps.
    Exception: Omit trap on indirect wastes, unless otherwise indicated.

20. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
21. Install dishwasher air-gap fitting on dishwasher standpipe.
22. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.
23. Install chrome-plated 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"
24. Set shower receptors and service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing"
25. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.
26. Provide chrome-plated anchor bolts and washers for all lavatories and china bolt caps for all floor-mounted water closets.

B. Water Heaters:

1. Free Standing Water Heaters.

   a. Install domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Division 03. Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
   b. Maintain manufacturer's recommended clearances.
   c. Arrange units so controls and devices that require servicing are accessible.
   d. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   e. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   f. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   g. Install anchor bolts to elevations required for proper attachment to supported equipment.
   h. Anchor domestic-water heaters to substrate.

2. Tankless, Domestic-Water Heater Mounting: Install tankless, domestic-water heaters at least 18 inches above floor, except under counter mounting, on wall bracket.

   a. Maintain manufacturer's recommended clearances.
   b. Arrange units so controls and devices that require servicing are accessible.
   c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   d. Install anchor bolts to elevations required for proper attachment to supported equipment.
   e. Anchor domestic-water heaters to substrate.

3. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
4. Gas Water Heaters:

   a. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 Section "General Duty Valves for Plumbing Piping."
   b. Install gas-fired, domestic-water heaters according to the International Fuel Gas Code.
   c. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
   d. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
   e. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.

f. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in other sections of Division 23.

5. Install domestic-water heaters with seismic-restraint devices where specified.
6. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
7. Install combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. Extend water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
8. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains.
9. Install thermometer on outlet piping of domestic-water heaters.
10. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet.
11. Provide isolation valves and dielectric couplings.
12. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
13. Fill domestic-water heaters with water.
14. Charge domestic-water compression tanks with air to domestic water static pressure.

3.3 CONNECTIONS

A. Water and gas piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Connections to individual fixtures shall not be less than sizes scheduled on the drawings unless otherwise specifically noted.

D. Provide rigid bracing for all stub-outs.

E. Ground equipment according to Division 26.

F. Connect wiring according to Division 26.

G. Provide heat piping-type heat traps on all non-circulated water heaters and storage tanks.

3.4 FIELD QUALITY CONTROL

A. Plumbing Fixtures and Trim

1. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
2. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
3. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
4. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
5. Confirm correct connection of hot and cold water supplies to fixtures.
6. Install fresh batteries in sensor-operated mechanisms.
7. Water closet fixtures not producing uniform rim flush and urinals not producing uniform wall flush shall be replaced.
8. Prepare test and inspection reports.

B. Water Heaters

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

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.
3. Remove labels.

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 the Owner.

END OF SECTION 22 3000

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SECTION 23 0500 - COMMON WORK RESULTS FOR MECHANICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

B. All electrical work installed under Division 23 shall be in compliance with Division 26.

1.2 SUMMARY

A. This Section includes the following:

1. General requirements for all Division 23 sections
2. Piping materials and installation instructions common to most piping systems
3. Dielectric fittings
4. Mechanical sleeve seals
5. Sleeves
6. Grout
7. Electric motors
8. Motor controllers
9. Miscellaneous electrical equipment
10. Access Panels
11. Identification
12. Mechanical demolition
13. Equipment installation requirements common to equipment sections
14. Painting and finishing
15. Concrete bases
16. Supports and anchorages

1.3 DRAWINGS AND SPECIFICATIONS

A. The drawings are diagrammatic in character indicating design concept and do not indicate every required duct or piping offset, valve, fitting, etc.

B. All drawings relating to this structure, together with these specifications, shall be considered in bidding and construction. The drawings and specifications are complementary, and what is called for in either of these shall be as binding as though called for by both. Should any conflict or omission arise between the drawings and specifications, such conflict shall be brought to the attention of the Architect/ Engineer for resolution.

C. Unless otherwise indicated, all equipment and performance data listed is for job site conditions (elevation 4,700 feet).

D. Drawings are not to be scaled.

1.4 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.5 WIND AND SEISMIC CRITERIA

A. All system components must comply with the wind and seismic requirements of Division 23 Section "Wind, Seismic, and Vibration Controls for Mechanical Work". These include requirements for anchorage, internal, and attached/imbedded components. Included are the minimum 2015 International Building Code requirements plus additional criteria for this project. Systems requiring systems and components to be designated with a Component Importance Factor of 1.5 and requiring certification are tabulated in Division 23 Section "Wind, Seismic, and Vibration Controls for Mechanical Work".

B. Seismic Performance: All Mechanical systems designated with a component importance factor of 1.5, including all components and accessories, shall withstand the effects of earthquake motions.

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. Division 23 Submittal Data and Shop Drawings:

1. Refer to Division 01, for general submittal requirements.
2. Contractor agrees that shop drawings and/or submittals processed by the Engineer are not change orders; that the purpose of shop drawings and/or submittals by the Contractor is to inform the Engineer which equipment and materials he intends to furnish and install.

3. Submittals and/or shop drawings are to be edited to show specific data and all options for the Mechanical equipment that the Contractor intends to provide.
4. Submittals and/or shop drawings are to be identified with numbers or letters identical to those listed on the drawings and/or specifications.
5. All shop drawings for special systems (temperature controls, etc.) that will become permanent record documents shall be prepared on AutoCAD Version 2012 or later, using the same drawing size as the project construction documents.
6. Approved Manufacturers and Substitutions

    a. Equipment and/or materials manufactured by any one of the Engineer-approved manufacturers listed in this specification or on the drawings shall be acceptable if the equipment and material is equivalent in performance, capacity, and configuration.
    b. Substitution Requests prior to bid: Refer to Division 01. No prior approvals will be given by the Engineer unless specifically mentioned in these specifications.
    c. Substitution Requests after Execution of Contract: If Contractor wishes to furnish or use a substitute item of material and/or equipment he must submit a change order request to the Engineer. The request for change order shall itemize each of the proposed substitutions identified by applicable specification section, paragraph number, and/or drawing number. A price change (increase or decrease) shall be listed for each item along with complete data showing performance over entire range, physical dimensions, electrical characteristics, material construction, operating weight, and other applicable data. Justification of substitution must be more than just cost justification. The Engineer will review the change order request for equality, suitability, and reasonableness of price differential. A single substitution change order listing the approved items will be issued with the net cost of the change order being the sum of the approved item costs. No subsequent substitution change orders will be considered. The Engineer's decision will be final.
    d. It shall be the responsibility of the Contractor to assure that the substitute material and/or equipment fits into the space provided and the Contractor shall pay for all extra costs incurred by other trades for any and all changes necessitated by these substitutions. No time extension will be allowed due to substitution on equipment.
    e. Equipment and/or materials manufactured by any one of the Engineer-approved manufacturers listed in this specification or on the drawings shall be acceptable if the equipment and material is equivalent in performance, capacity, and configuration.

7. Submittals Schedule:

    a. Comply with Division 01 construction progress documentation and submittal requirements and the additional submittal requirements specified below. . Unless otherwise specified in Division 01, comply with the submittal periods specified below. Engineer will schedule submittal reviews based upon submittal schedule. Failure to submit schedule may result in inability to review submittals within the periods stated in the submittal schedule. These delays shall not be cause for extension of Contact completion date.

        1) Processing Time: Allow enough 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.

2) Submit schedule within 14 days of commencement of work. 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.
3) Allow 15 days for review of each resubmittal.
4) Submit a minimum of three copies of schedule. Arrange the following information in a tabular format:

a) Scheduled date for first submittal.
b) Specification Section number and title.
c) Submittal category (action or informational).
d) Name of subcontractor.
e) Description of the Work covered.
f) Scheduled date for Architect's final release of reviewed submittal.

8. Schedule of Deviations: Equipment and material submittals of approved manufacturers, including basis of design manufacture shall provide a written itemization of exceptions to the specification and deviations from the basis of design for all features, design, configuration, physical dimension, performance, and operation of the submitted product. Those elements not identified and itemized as exceptions in the submittal shall not be reviewed by the Engineer and shall be provided as specified.

B. Manufacturer Seismic Qualification Certification: Submit certification that equipment, mounted and separately mounted accessories and components meet the criteria specified in Division 23 "Wind, Seismic, and Vibration Controls for Mechanical Work" and will withstand the effects of earthquake motions determined according to ASCE 7 and remain operational.

1. Basis for Certification: State whether certification is based upon an actual test on a shake table, by three-dimensional shock tests, by an analytical method using dynamic characteristics and forces, by the use of experience data (i.e., historical data demonstrating acceptable seismic performance) or by a more rigorous analysis providing for equivalent safety.
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. Close-out Submittals:

1. Operating and Maintenance (O&M) Manual:

a. Provide O&M manuals in accordance with Division 01.
b. The Contractor shall prepare an operating and maintenance manual that shall cover all systems and equipment installed under this Division. Incorporate the standard technical literature into system-specific formats for this facility as designed and actually installed. The resulting manual shall also serve as the training manual and shall be specific, concise, to the point, and tailored specifically for this facility.

c. Unless specified otherwise in Division 01, the maintenance manual shall be submitted to the Engineer in draft form for approval prior to preparation of three copies for final submission to the Architect for delivery to the Owner.
d. The maintenance manual shall be 8-1/2" x 11" size and assembled in loose-leaf three-ring or post binder. Provide manufacturers' original literature. Facsimiles are not acceptable. The manual shall be adequately indexed and contain the following information:

1) Contractors' names, addresses, and telephone numbers.
2) Alphabetical list of all system components with the name and address and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
3) Guarantees and warranties of all equipment whenever applicable.
4) All manufacturers' data that is applicable to the installed equipment, with appropriate highlighting, such as the following:

a) Shop drawings (latest copy)
b) Installation instructions
c) Lubrication instructions
d) Wiring diagrams

5) A simplified description of the operation of all systems including the function of each piece of equipment within each system including both normal and emergency operation. These descriptions shall be supported with a schematic flow diagram when applicable.

2. Record Drawings:

a. Comply with record drawing requirements in Division 01.
b. Record Prints: All RFIs, change orders and other directives if not recorded on the contract drawings and amendments shall be red-lined on the record drawings. Record drawings simply tabulating the amendments onto the drawings shall be returned for clarification of installed conditions and red-line mark-up.

D. Non-Responsive Submittals: Submittals are intended to be reviewed in an initial submittal with comments corrected and submitted in a resubmittal. Non-responsiveness to the initial submittal comments in the resubmittal will result in return of the documents for correction and additional resubmittals. Any time charged by the Engineer in review of additional resubmittals due to non-responsiveness shall be deducted from the Contractor's billings.

E. Product Data: for the following:

1. Dielectric fittings
2. Mechanical sleeve seals
3. Motor Submittal Data: The following data shall be submitted for all motors:

a. Full load current and service factor running current at operating voltage.
b. Locked rotor current, starting power factor, and power factor at full load.
c. Efficiency at full load.

d. Data to substantiate Class F insulation with Class B rise at 100% load.
e. Full load speeds (rpm).
f. Enclosure type (ODP, TEFC, explosion proof, TENV, WPI, etc.)

Note: All tests (except locked rotor current) shall be made at full voltage and rated frequency.

4. Motor Controllers:

a. Torque, speed, and horsepower requirements of the load.
b. Ratings and characteristics of supply circuit and required control sequence.
c. Ambient and environmental conditions of installation location.

5. Capacitor size (KVAR) for maximum power factor correction at 95% lagging.
6. Identification: Submit product for each type of identification.

F. Certification:

1. Welding certificates
2. Certificates of Compliance for all Designated Seismic Systems.

G. Schedules:

1. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
2. Valve numbering scheme.
3. Valve Schedules: For each piping system to include in maintenance manuals.

1.7 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" ASME Section VIII, and ANSI 313.

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 (within 6 months).
3. Electric metallic arc process shall be used for all welding. End preparations shall conform to ANSI and ASTM Standards.
4. The Contractor shall submit three copies of each welder's qualification test report to the Engineer and University Project Manager for approval prior to commencing the work. No welder shall be used on the project until so certified and approved by the University Project Manager.

C. Electrical Characteristics for Mechanical Equipment: Equipment of lower or higher electrical characteristics may be furnished provided such proposed equipment variations are specifically

identified as a deviation from contract documents and approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at no cost to the Owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.8 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 piping to prevent sagging and bending.

1.9 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for Mechanical 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 Mechanical items requiring access that are concealed behind finished surfaces.

D. Identification:

1. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
2. Coordinate installation of identifying devices with locations of access panels and doors.
3. Install identifying devices before installing acoustical ceilings and similar concealment.

E. Coordinate with all trades to maintain clearances to access panels, equipment, control and electrical panels. Intrusions into access space shall be brought to the attention of other trades. Notify Engineer of conflicts shown on drawings prior to installation.

F. Prior to fabricating work or commencing the work, Contractor shall prepare coordination drawings combining disciplines of all trades prior to installation of systems and equipment. Indicate architectural, structural, HVAC, plumbing, fire protection, electrical, and telecommunications. Drawings shall correlate with elements of all trades to predict and prevent conflicts and identify pathways and adequate space. Drawings shall identify required access to equipment and panels and shall identify zones over electrical panels and equipment to be free of ductwork and piping.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 Mechanical piping Sections for pipe, tube, and fitting materials and joining methods.

1. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 Mechanical 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. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

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.

G. 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 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: Use dielectric couplings.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig minimum working pressure as required to suit system pressures.

1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Division

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. Available 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°F .

1. Available Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

2.5 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
   e. PSI/Thunderline/Link-Seal

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: Zinc dichloromate or glass reinforced plastic. 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.

2.6 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A53, 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.

2.7 GROUT

A. Description: ASTM C1107, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.8 ELECTRIC MOTORS

A. General: All motors (except as noted) shall conform to the following specifications:

1. Comply with requirements in this Section except when stricter requirements are specified in Mechanical equipment schedules or sections.
2. 1/2 hp and Smaller: Single-phase.
3. Larger than 1/2 hp shall be 3-phase, except where specifically noted otherwise.
4. Comply with NEMA MG 1 unless otherwise indicated.
5. Motors shall be UL listed for intended use.

B. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40°C and at site elevation.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Polyphase Motors:

1. Description: General purpose NEMA MG 1, Design B, except "C" where required for high starting torque, medium induction motor.
2. Efficiency: NEMA Premium Efficiency, as defined in NEMA MG 1 when available, otherwise energy efficient, as also defined therein.
3. Service Factor: 1.15.
4. Multispeed Motors: Separate winding for each speed.
5. Rotor: Random-wound, copper windings, squirrel cage.
6. Bearings:

    a. Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading, minimum 40,000 hour L10 life.
    b. Sleeve type bearings are permitted for fractional horsepower and light-duty motors.
    c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.

7. Insulation: Class F.
8. Code Letter Designation:

    a. Motors 15 hp and Larger: NEMA starting Code F or Code G.
    b. Motors Smaller than 15 hp : Manufacturer's standard starting characteristic.

9. Enclosure:

    a. Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
    b. Open drip-proof motors for indoor use where satisfactorily housed and properly ventilated during operation.
    c. Weather protected Type I for outdoor use when enclosed or housed with adequate ventilation.

d. TEFC in mechanical areas of the heat plant and when exposed to weather or moist locations.
e. Special enclosures required for hazardous areas (explosion proof, etc.) per equipment schedules. Explosion-proof motors shall be UL listed.

10. Motor Selection Criteria:

a. Motor sizes shall be large enough so that the driven load will not require the motor to operate above 80% of its rated horsepower. Minimum horsepower ratings are shown or scheduled on the drawings.
b. Pump motors shall be "non-overloading"; i.e. shall not operate in service factor at any point on pump curve.

D. Additional Requirements for Special Polyphase Motors.

1. Motors Used with Reduced-Voltage and Multi-speed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
b. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
c. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
d. Shaft grounding kits, Aegis SGR, Shaft Grounding Systems, Model G JR, or approved equal.

E. Single Phase Motors:

1. Motors shall be one of the following, to suit starting torque and requirements of specific motor application:

a. Permanent-split capacitor (PSC).
b. Split phase.

2. Multispeed Motors:

a. Electronically commutated motor (ECM): Provide ECM motors with speed control when available as an option.
b. Variable-torque, permanent-split-capacitor type.

3. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.9 POWER FACTOR CORRECTION

A. Capacitors shall be installed on all motor/controller combinations 25 hp and larger that have an uncorrected power factor of less than 90% at rated load. KVAR size shall be as required to correct motor power factor to 95% lagging.

B. Capacitors shall have:

1. Individual unit cells
2. All welded steel housings
3. Non-flammable synthetic liquid impregnant
4. Craft tissue insulation
5. Aluminum foil electrodes

C. Each capacitor shall be internally fused.

2.10 MOTOR CONTROLLERS

A. General Motor Controller Characteristics:

1. Single speed and multi-speed motor controllers shall be combination type, full NEMA-rated starters with fused or non-fused disconnect switch for all motors provided.

   Exception: Starters that are shown to be provided integral within packaged equipment, control panels with door mounted disconnects or in motor control centers.

2. All combination starters shall be adequately braced for the fault current available 42,000 AIC @ 480V, 3-phase and 65,000 AIC @ 208V, 3-phase shall be the minimum ratings.
3. All starters, whether separately furnished or integral with equipment, shall comply with the following:

   a. Enclosures: NEMA Type 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA Type 4 with conduit hubs, or units in hazardous locations that shall have NEC proper class and division explosion proof enclosure. Mechanical areas of the heat plant shall be considered wet locations.
   b. 3-phase Starters:

      1) All starters for 3-phase motors shall be magnetic complete with the following accessories.

         a) Three-leg electronic overload protection with 3-phase voltage monitor to provide quick-trip on single phasing, phase reversal, or high/low voltage with externally operated manual reset and visual trip indicator. Trip setting shall be adjustable with locking cover; initial trip setting shall be Class 10.
         b) Control transformers with fused primary and secondary per NEC.
         c) 120-volt holding coils.
         d) Integral Hand-Off-Auto switch for single-speed motors.
         e) Integral High-Low-Off-Auto switch for two-speed starters.
         f) High- to low-speed compelling time delay relay for two-speed starters.

g) Integral Forward-Reverse-Off-Auto switch for starters serving reversible motors.
h) Compelling time delay relay for starters serving reversible motors.
i) Auxiliary contacts, one normally open and one normally closed minimum.
j) "Run" pilot light.

2) Approved full NEMA rated starters are Allen-Bradley, Bulletin 500; General Electric, 300 Line; and Square D, Type S.

c. Single-phase Starters: Starters shall be shall be horsepower-rated thermal overload switches.

B. Refer to Section 26 2923 for Variable Frequency Drives.

2.11 MISCELLANEOUS ELECTRICAL DEVICES

A. Furnish all necessary control devices such as speed controls, transformers, and relays as required for proper operation of all equipment furnished under this Division.

B. Furnish all remote switches and/or pushbutton stations required for manually operated equipment complete with low energy pilot lights of an approved type.

C. Enclosures: NEMA Type 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA Type 4 with conduit hubs, or units in hazardous locations that shall have NEC proper class and division explosion proof enclosure. Mechanical areas of the heat plant shall be considered wet locations.

D. Furnish circuit and purpose identification for each remote manual switch and/or pushbutton station furnished herein. Identification may be either engraved plastic sign for permanent mounting to wall below switch, or stamping on switch coverplate. All such identification signs and/or switch covers in finished areas shall match other hardware in the immediate area.

2.12 ACCESS PANELS OTHER THAN SHEET METAL

A. Access panels are to have Underwriters' Laboratories B label fire rating when installed in fire-rated walls or ceiling.

B. Access panels for installation in plaster are to be similar to Milcor style "K," all other access panels are to be similar to Milcor style "M."

2.13 IDENTIFICATION

A. Equipment Labels:

1. Plastic Labels for Equipment:

   a. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
   b. Letter Color: White.
   c. Background Color: Black or blue.
   d. Maximum Temperature: Able to withstand temperatures up to 160°F.
   e. Minimum Label Size: Length and width vary for required label content, but not less than 3 x 1 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.

2. Equipment nameplates shall include the following minimum information:

   a. Plan identification
   b. Capacity specified at designed operating conditions
   c. Actual capacity as balanced at site operating conditions
   d. Area or zone served

3. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2" x 11" 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.

B. Pipe and Duct Identification:

1. All accessible duct and piping shall be color coded and identified with wording and arrows every 50 feet, at each riser, at each junction, at each access door, and where required to easily identify the medium transported.
2. Duct and piping systems shall be identified by background color, lettering color, and flow direction arrow.
3. Duct and piping background color shall be applied to all exposed piping (either over bare pipe or the insulation) in mechanical rooms. Identifying lettering and arrows shall then be added as indicated above, and as necessary to be visible from anywhere in the room.

   a. For duct in mechanical rooms, chases, and other exposed areas, as well as piping routed in other exposed areas such as chases, background color shall be applied in a 2-foot-wide band with identifying lettering and a flow direction arrow.

b. Background and lettering shall be semi-gloss enamel paint by DeVoe (Mirrolac), Pratt and Lambert, Glidden, Rust-Oleum, Sherwin Williams or prior approved equal. The colors specified herein shall not vary.

Color	Sherwin Williams	Pratt & Lambert	Rust-Oleum
Red	SW4081 Safety Red	1007 Vibrant Red	964 Federal Safety Red
Orange	SW4083 Safety Orange	S4507Safety Orange	956 Federal Safety Orange
Yellow	SW4084 Safety Yellow	1732 Spectrum Yellow	944 Federal Safety Yellow
Green	SW4085 Safety Green	Safety Green	933 Federal Safety Green
Blue	SW4086 Safety Blue	1228 Anchors Aweigh	925 Federal Safety Blue
Purple	SW4080 Plum	Bright Medium	Bright Medium
Silver (Aluminum)	B59S11 Silver Brite	--	--
Black	Black	Effecto Black	634 Black
White	White	Effecto White	2766 White
Brown	SW4001 Bolt Brown	2278 Char Brown	--

Note: University experience has shown that Mirrolac works well in this application, being durable with excellent coverage.

c. Identifying lettering shall be painted or stenciled on duct or pipe over the background color. Self-adhesive or glue-on type labels are acceptable. Letters shall be 2" high for duct and larger piping 3" or more, 1" high for 1-1/4" to 2-1/2" pipe, and 1/2" high for 1" pipe and smaller.

d. Arrows to indicate direction of flow shall be painted over the background color in the same color as the lettering. The arrow shall point away from the lettering. On duct and large piping 3" or more in diameter, the "shaft" of the arrow shall be 2" long and 1" wide. Smaller piping, 2-1/2" or less, shall have arrows with a shaft 1/2" wide and 2" long. Use a double-headed arrow if the flow can be in either direction.

e. Piping and duct shall be identified with the following colors:

Service	Background	Identifying Lettering	Lettering
Natural Gas	Brown	NATURAL GAS	Yellow
Compressed Air	Silver	COMPRESSED AIR	Black
Instrument Air	Yellow	INSTRUMENT AIR	Black
Nitrogen	Silver	NITROGEN	Black
Boiler Blow-Off	Yellow	BLOW-OFF WATER	Black
Non Potable	Green	UNSAFE WATER	Black
Cold Water	Green	DOMESTIC COLD WATER	White
Softened Water	Green	SOFTENED WATER	Black
Chilled Water Supply	Blue	CHILLED WATER SUPPLY	White
Chilled Water Return	Blue	CHILLED WATER RETURN	White
Cooling Water Supply	Blue	COOLING WATER SUPPLY	White
Cooling Water Return	Blue	COOLING WATER RETURN	White
High Temp Supply	Yellow**	HIGH TEMP WATER SUPPLY	Black

Service	Background	Identifying Lettering	Lettering
High Temp Return	Yellow**	HIGH TEMP WATER RETURN	Black
System Make-Up	Green	MAKE-UP WATER	White

***Note: Directional arrows required on HTHW Piping*

C. Valve Tags:

1. Valve Schedules: For each piping system, on 8-1/2" x 11" 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. List valve size if NPS 3 and larger. Mark valves for emergency shutoff and similar special uses.

   a. Submit valve schedule and a map or drawing of the valve tags to Engineer and Owner for approval prior to making valve tags. The flow diagram or P&ID diagram in the contract documents may be used as basis for the "map" with additional valves hand-written onto the diagrams.
   b. Valve-tag schedule shall be included in operation and maintenance data.

2. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

   a. Tag Material: Brass, 3 x 1 inch rectangular, 0.051-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   b. Fasteners: Steel ring.

3. Each valve on the drawing shall be identified separately, and valve tags shall match the drawing identification. Valve tags shall be connected to valve stems by steel rings and include the following minimum information:

   a. System or Equipment identification

      1) High Temperature Water Systems HTW-xxx
      2) Cold and Softened Water Systems DCW-xxx
      3) (Process) Cooling System PCW-xxx
      4) Chilled Water System CHW-xxx
      5) Compressed Air System CDA-xxx

   b. Normal position
   c. Duty
   d. Area served
   e. Valve type
   f. Additionally, heating water valves, steam valves, and all valves located in the secondary (low pressure) side of HTW heat exchangers shall include the manufacturer, size, grade, and pressure-temperature service rating.

PART 3 – EXECUTION

3.1 MECHANICAL DEMOLITION

A. Refer to Division 01 and Division 02 for general demolition requirements and procedures.

B. Disconnect, demolish, and remove Mechanical 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 the Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying Mechanical piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
   c. Insulated Piping: Split, cast-brass type with spring clips.
   d. Bare Piping at Wall, Floor, and Ceiling Penetrations in Finished Spaces, Unfinished Service Spaces, and Equipment Rooms: One-piece or split, cast-brass type with polished chrome-plated finish.

2. Existing Piping: Use the following:

   a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
   b. Insulated Piping: Split, cast-brass type with spring clips.
   c. Bare Piping at Wall, Floor, and Ceiling Penetrations in Finished Spaces, Unfinished Service Spaces, and Equipment Rooms: Split, cast-brass type with polished chrome-plated finish.

M. Sleeves through floors shall extend 2 inches above floor level for core-drilled holes and sealed to the floor to prevent water passage. Sleeves are not required for core-drilled holes through walls.

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.

   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, seismic installation may require additional clearance:

   a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions. 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 fire and smoke rated joint sealants appropriate for size, depth, and location of joint.

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. 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 listed for application.

R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

T. Install dielectric fittings or approved adaptor fittings on all joints between different piping materials on steam, hot water, chilled water, condenser water, steam condensate, ground source heat pump loop systems and other hydronic mechanical piping systems.

U. Old Pipe Lines: If any old sewer, water, gas, or other pipes are encountered that interfere with the proper installation of new work and that will not be used in connections with the new work, close all openings in proper manner or, if necessary, relocate or remove the pipes as shown on plans. Should any old pipes and/or electrical lines not shown on plans be encountered, immediately notify Owner's representative before taking any action.

3.3 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.

1. Welding:

a. All welding on piping, including tack welding, shall be performed by welders currently qualified and certified for the applicable welding process. See Part 1 of this section. A file shall be maintained for examination upon request of all qualified weld procedures and the names of the qualified welders performing this work.
b. Each welder, upon beginning the weld, will stamp his assigned welder code into the pipe. Each joint shall be performed by a single welder.
c. Examine the inside of each length of piping to make sure it is free from dirt and obstructions. If obstructed in any way, the pipe shall be swabbed out before being incorporated into the system.
d. Before and after piping fabrication, all flanges, threaded connections, and beveled pipe ends shall be protected with end protectors and suitable grease to prevent corrosion and damage until installed into the system.
e. Before welding, the end of the pipe and fittings shall be cleaned of rust, scale, dirt, grease, protective coating, or other foreign matter which might affect the quality of the welds.
f. When pipes of different wall thicknesses are to be welded together, the end of the thicker pipe shall be smoothly tapered to the wall thickness of the thinner pipe. The taper angle shall not be more than 30° from the axis of the pipe.
g. Before welding, the piping shall be aligned as required in ASME Code for Pressure Piping B31.
h. Pipe, flanges, and fittings damaged during fabrication or shipment shall be repaired or replaced, as specified by the Engineer. Any damaged section shall be removed from the job site.
i. The necessity of preheating of welds and the temperature used are a requirement of the weld procedure. If the metal temperature is below 32°F, local preheating to a temperature warm to the hand is required for materials which otherwise do not require preheating.

j. The preparation of butt welding ends of pipe, welding neck flanges, pipe fittings, and any other piping component, including valves which are butt welded into the piping system, shall be in accordance with ANSI B16.25 with the following exceptions:

1) No permanent backing rings shall be used.
2) Use of consumable inserts is permitted and encouraged as a means of obtaining required weld quality.

k. Spacers may be used in fitting up pipe and weld fittings for tack welding to a proper gap for full penetration welds. Small tack welds which penetrate to the bottom of the welding groove shall be used. Tack welds lacking full penetration are not acceptable and shall be removed.

l. All pipe welds that allow visual inspection on the inside and that can be reached by hand shall be inspected by the welder immediately after welding, and the following action shall be taken:

1) Weld spatter, flux, and debris shall be removed.
2) Excessive penetration shall be removed by grinding.
3) Areas without penetration or fusion shall be ground to sound-metal and repair welded.

m. Cleaning of excessive flux shall be performed between welding passes using wire brushing or grinding.

n. Flanges welded to pipe spools shall be oriented with the bolt-holes straddling the centerlines established on the piping drawings. Take precautions throughout fabrication not to mar the gasket face on flanges.

o. Weld slip-on flanges on both front and back sides.

p. Thermometer wells and test wells shall be back welded.

2. Weld Examinations:

a. Required non-destructive examinations for pipe welds are as shown in Table 136.4 of ASME B31.1, Power Piping of the ASME Code for Pressure Piping. The Contractor shall be responsible for all costs associated with required non-destructive examinations. The contractor shall perform visual examination of all welds.

1) Visual examinations shall be performed by certified individuals as outlined in ASME B31.1, Power Piping with criteria for acceptability as noted in Part 136.
2) The certified individual performing visual weld examinations may be an employee of the Contractor but may only examine welds performed by others.
3) The individual(s) performing visual weld examinations shall keep an updated log of welds examined, stating acceptability, and any corrective action taken.

b. The Owner's representative will perform random non-destructive testing of work executed in addition to examinations required by ASME B31.1. The Owner shall bear the cost of radiographic examination of weld joints performed by the Contractor and the Owner's representative shall select joints to be tested. The Contractor shall repair, at no extra cost to the Owner, all welds failed under RT examinations and shall pay the cost to retest the weld. If more than 10% of the examined welds of any

individual welder fail, the Contractor shall assume responsibility and costs to examine any and all welds made by that welder and selected by the Owner's representative.

c. Criteria for acceptability shall be as shown in ASME B31.1, Power Piping, Part 136. Spot or random radiographic testing shall apply to high-temperature water systems.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 ACCESS PANELS

A. Provide access panels where required for access to concealed Mechanical items such as dampers, valves, strainers, shock absorbers, cleanouts, control devices, and where required for equipment servicing.

3.5 IDENTIFICATION COMMON REQUIREMENTS

A. Preparation: 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.

B. Equipment Label Installation:

1. Install or permanently fasten labels on each major item of Mechanical equipment.
2. Locate equipment labels where accessible and visible.

C. Pipe and Duct Label Installation:

1. Piping Color-Coding per University of Utah Standards.
2. Locate pipe and duct labels where 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:

   a. Near each valve and control device.
   b. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   c. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   d. At access doors, manholes, and similar access points that permit view of concealed piping or duct.
   e. Near major equipment items and other points of origination and termination.
   f. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

D. Valve Tag Installation: Install tags on valves and control devices in piping systems, except check valves. List tagged valves in a valve schedule.

1. Valve-Tag Application: Label all valves with tags indicating service and number. Securely fasten with steel ring. Match the service abbreviations given on Mechanical drawings.

3.6 PAINTING

A. Painting for identification of Mechanical systems, equipment, and components is specified in Part 2.13, Identification above.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Primer and paint pipe, ductwork, and equipment located outdoors unless surfaces are galvanized. Use primer and paint rated higher than normal operating temperature of the component.

3.7 CONCRETE BASES & GROUT

A. Concrete Base:

1. Anchor equipment to concrete base according to equipment manufacturer's written instructions.
2. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit.
3. 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.
4. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Install anchor bolts to elevations required for proper attachment to supported equipment.
7. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
8. Use 4000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03.

B. Grouting:

1. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
2. Clean surfaces that will come into contact with grout.
3. Provide forms as required for placement of grout.
4. Avoid air entrapment during placement of grout.
5. Place grout, completely filling equipment bases.
6. Place grout on concrete bases and provide smooth bearing surface for equipment.
7. Place grout around anchors.
8. Cure placed grout.

C. Provide 4" wide x 4" tall concrete curb for ducts penetrating through floors unless duct is enclosed in a chase. Anchor curb to floor at corners and at 18 inches on-center around perimeter, provide horizontal rebars around curb, roughen the existing concrete under the curb, and apply bonding agent before pouring concrete.

D. Seismic Coordination: Coordinate base with Division 23 Section "Wind, Seismic, and Vibration Controls for Mechanical Work" for additional requirements.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 for structural steel and Division 23 Section "Wind, Seismic, and Vibration Controls for Mechanical Work" for additional requirements.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.9 CLEANING

A. Cleaning and Flushing:

1. All water circulating systems for the project shall be thoroughly cleaned before placing in operation to rid the system of dirt, piping compound, mill scale, oil, and any and all other material foreign to the water being circulated.
2. Extreme care shall be exercised during construction to prevent all dirt and other foreign matter from entering the pipe or other parts of the system. Pipe stored on the project shall have the open ends capped, and equipment shall have all openings fully protected. Before erection, each piece of pipe, fitting, or valve shall be visually examined and all dirt removed.

    a. Heating Water Systems: High-temperature water heating systems, including converters, pumps, coils, and piping shall be cleaned per Section 23 25 00, Water Treatment.

3. After the system (or portion thereof) has been leak tested, thoroughly flush with clean water. During the clean water flush, all valves shall be full open, the flow rate for flush shall be at least 4 ft./sec., and the total flow shall equal at least five times the total piping system volume. Flushing shall continue until water runs clear.
4. After clear water flushing is complete, a chemical flushing solution, shall be utilized to remove oil, grease, piping compounds, etc. After the system is filled with this solution, the system shall be brought up to temperature and allowed to circulate for at least eight hours. The system shall then be drained completely and reflushed with fresh water.
5. After the system has been completely cleaned as specified herein, it shall be tested by litmus paper or other dependable method and left on the slightly alkaline side (pH = 7.5+). If the system is found to be still on the acid side, the chemical flush shall be repeated as necessary.

6. The Owner's representative shall be given notice of this cleaning operation. If the Owner's representative deems it necessary, the cleaning operation shall be repeated.
7. "Stop-Leak" compounds shall not be added to the system at any time.
8. Immediately after clear water flushing is complete, a chemical corrosion inhibitor solution, as furnished by the Division 23 Section "Water Treatment," Vendor/Contractor, shall be utilized to initially treat the system.
9. Clean exterior of piping prior to application of coatings.

B. Clean-up:

1. Clean coils and plenums.
2. Clean under, in and around equipment.
3. Clean exposed surfaces of ducts, piping, and equipment.
4. Clean equipment cabinets and enclosures.
5. Provide all new filters for equipment.

END OF SECTION 23 0500

SECTION 23 0523 – GENERAL DUTY VALVES FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

1.2 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure
2. EPDM: Ethylene-propylene-diene terpolymer rubber
3. PTFE: Polytetrafluoroethylene plastic
4. SWP: Steam working pressure
5. TFE: Tetrafluoroethylene plastic

1.3 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.4 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for valves up to 125 psig and ASME B31.1 valves above 125 psig.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: NSF 372 for valve materials for potable-water service.

D. Source Limitations: Obtain valves of a single type through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.

2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, 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.
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 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 and smaller with threaded or soldered ends.

C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive: For quarter-turn valves NPS 8 and larger.
3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
5. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

G. Extended Valve Stems: On insulated valves.

H. Valve Ends:

1. Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
2. Grooved: AWWAC606.

3. Solder Joint: With sockets according to ASMEB16.18.

   a. Caution: Use solder with melting point below 840°F for angle, check, gate, and globe valves; below 421°F for ball valves.
   b. Threaded: With threads according to ASME B1.20.1.

I. Valve Bypass and Drain Connections: MSSSP-45

2.2 BALL VALVES

A. Bronze Two-Piece Ball Valves:

1. Manufacturer and Model:

   a. Threaded Ends:

      1) Apollo 77C-100 Series
      2) Hammond 8501
      3) Nibco T-585-70

   b. Soldered Ends:

      1) Apollo 77C-200 Series
      2) Hammond 8511
      3) Nibco S-585-70

2. 150 psig SWP, non-shock 600 psig WOG, MSS SP-110, cast bronze, full port, two-piece body design, chrome-plated solid bronze ball with reinforced Teflon seats. Stem packing adjustable for wear with adjusting screw.

B. Carbon Steel Three Piece Ball Valves:

1. Manufacturer and Model:

   a. Threaded Ends: Apollo 70-140-64

      1) Bronze, threaded, 250 psig SWP valve with 316 SS ball and stem; multi-fill seats and stuffing box ring; yellow vinyl grip with red lettering; sizes 1/4 inch to 3 inch.

   b. Socket Weld Ends: Apollo 83-540/640-64 Series

      1) ASME B16.34, Class 600, end connections; socket-weld per ASME B16.11, valve marking: ASME B16.34.

2. 250 psig SWP, non-shock 1500 psig WOG, carbon steel, full port, three-piece body design, stem extension, stainless steel ball with Teflon seats, stem packing shall be adjustable for wear with adjusting screw,.

C. Hose End Valves:

1. Manufacturer and Model:

a. Threaded Ends:

1) Apollo 70-100HC Series
2) Nibco T-585-70-HC

b. Soldered Ends:

1) Apollo 70-200HC Series
2) Nibco S-585-70-HC

2.3 BUTTERFLY VALVES

A. Flangeless Ferrous Alloy Butterfly Valves:

1. Manufacturer and Model:

a. Apollo L 141
b. Centerline 200
c. Keystone Fig 222
d. NIBCO LD 2000

2. Flangeless, 200 psig CWP Rating through NPS 12, 150 psig CWP Rating NPS 14 and larger, MSSSP 67, cast or ductile iron body, wafer lug type, extended neck, aluminum bronze or nickel plated ductile iron disc, stainless steel shaft, EPDM seat and seal, 10-position lever locking handle through NPS 6, worm gear actuator for NPS 8 and larger valves.

B. Valves shall be capable for use as isolation valves and be recommended by the manufacturer for dead-end service at the full-rated operating pressure, without the need for downstream blind flanges.

2.4 ECCENTRIC VALVES

A. Balancing Service:

1. Threaded, Class 125:

a. Milliken MILLCENTRIC
b. SMG Key Port Valve Fig. 425

2. Flanged, Class 125:

    a. Manufacturer and Model:

        1) DeZurik Fig. 118
        2) Milliken MILLCENTRIC
        3) Nibco F737
        4) Resun

3. Corrosion-resistant, permanently lubricated plug-type or multi-turn hand wheel with suitable seals for intended service, lever or multi-turn operator for valves through 6 inches, worm gear or multi-turn actuator for 8 inches and larger valves, adjustable memory stops all sizes.

2.5 GLOBE VALVES

A. Threaded, 150 psig SWP, non-shock 300 psig WOG, MSS SP-80, Class 150, bronze, union bonnet, Teflon disc.

1. Manufacturer and Model:

    a. Apollo 122T
    b. Nibco T-235
    c. Milwaukee 590-T
    d. Stockham B22T

B. Flanged ends, 125 psig SWP, non-shock 200 psig WOG, MSS SP-85, iron body, bronze trim.

1. Manufacturer and Model:

    a. Apollo 711F
    b. Nibco F-718-N
    c. Milwaukee F-2981
    d. Stockham G512

C. Threaded end, 300 psigSWP, non-shock 600 psig WOG, MSS SP-80, Class 300 bronze, union bonnet, Teflon disc.

1. Manufacturer and Model:

    a. Apollo127T
    b. Nibco T275 Y
    c. Milwaukee 572
    d. Stockham B-66

D. Flanged end, 250 psig SWP, non-shock 500 psig WOG, MSS SP-85, iron body, bronze trim.

1. Manufacturer and Model:

a. Apollo 721F
b. Nibco F-768-B
c. Stockham F-532

2.6 SILENT SPRING LOADED CHECK VALVE

A. Wafer type, MSS SP-80, Class 125, bronze or cast iron body, center guided, aluminum bronze disk, EPDM seats, monel or stainless steel springs

1. Manufacturer and Model:

a. Nibco W910-SS
b. Metraflex Silent Check
c. Milwaukee Series 1400
d. Titan CV-41
e. Val Matic VM-1400 Series

2.7 SWING CHECK VALVES

A. Bronze, 150 psig SWP, 300 psign on-shock WOG, MSS SP-80, Class 150, renewable bronze disc.

1. Manufacturer and Model:

a. Threaded:

1) Apollo 164T
2) Nibco T-433B
3) Milwaukee 510-T
4) tockham B-321

b. Soldered:

1) Apollo 164S
2) Nibco S-433B
3) Milwaukee 1510-T
4) Stockham B-309Y

B. Flanged, iron body, 125 psig SWP, 200 psig non-shock WOG, MSS SP-71, Class 125, bronze trim.

1. Manufacturer and Model:

a. Apollo 910F

b. Nibco F-918 B
c. Milwaukee F2974A
d. Stockham G-931

C. Grooved, iron body, 125 psig SWP, 200 psig non-shock WOG, MSS SP-71, Class 125, bronze trim.

1. Manufacturer and Model:

a. Gruvlok 7811
b. Victaulic Series 712

D. Threaded, bronze, 300 psig SWP, 600 psig non-shock WOG, MSS SP-80, Class 300, renewable bronze disc.

1. Manufacturer and Model:

a. Apollo 168T
b. Nibco T-473B
c. Milwaukee 507
d. Stockham B-375

E. Flanged, iron body, MSS SP-71, Class 250, bronze trim.

1. Manufacturer and Model:

a. Apollo 920 F
b. Nibco F-968-B
c. Stockham F-947

2.8 CHAINWHEEL ACTUATORS

A. Manufacturers:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after 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.

G. Do not install any valve that does not meet the pressure and temperature requirements of the system into which the valve is placed.

3.2 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

1. Shutoff Service:

   a. Water and Glycol:

      1) NPS 2 and Smaller: Ball valves.
      2) NPS 2-1/2 and Larger: Butterfly valves

2. Throttling Service:

   a. NPS 2 and Smaller: Bronze, Class 150, threaded.
   b. NPS 2-1/2 and Larger: Iron body, Class 125, flanged.

3. Pump Discharge:

   a. NPS 1-1/2 and Smaller: Bronze, Class 150, threaded.
   b. NPS 2 and Larger: Wafer, silent spring check valves.
   c. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

B. Chilled Water Piping: Use the following types of valves:

1. Ball Valves, NPS 2 and Smaller: Bronze two-piece, threaded or soldered.
2. Butterfly Valves, NPS 2-1/2 and Larger:

   a. Flangeless, ferrous alloy.
   b. Grooved ferrous alloy where grooved piping is permitted.

3. Check Valves:

   a. Pump Discharge:

      1) NPS 1-1/2 and Smaller: Bronze, Class 150, threaded.
      2) NPS 2 and Larger: Wafer, silent spring check valves.
      3) Grooved, silent spring check valves where grooved piping is permitted.

   b. Other than Pump Discharge: Bronze, Class 150.

      1) NPS 2 and Smaller: Bronze, Class 150, threaded.
      2) NPS 2-1/2 and Larger: Iron body, Class 250, flanged.

4. Balancing Valves:

   a. NPS 2 and Smaller: Threaded, Class 125.
   b. NPS 2-1/2 and Larger: Flanged Class 125.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. All equipment and materials shall be installed in accordance with the recommendations of the manufacturer.

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. All valves shall be installed so they are accessible and serviceable. Install valves in position to allow full stem movement.

G. All valves shall be installed so the stem position is not more than 90-degrees from the vertical up position.

H. Install chainwheel operators on valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor elevation.

I. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

J. Isolation valves shall be installed:

   1. In piping at each and every piece of equipment
   2. In piping whenever said pipe enters or leaves an equipment room

3. At all branch take-offs from mains
4. Where shown on drawings

K. Where butterfly valves are located five pipe diameters or less from an elbow, install the valve with its shaft parallel to the plane of the elbow.

L. Valve identification requirements are in other Division 23 sections.

3.4 JOINT CONSTRUCTION

A. Refer to Division 23 Section "Common Work Results for HVAC" for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions. Seats and gaskets shall meet the temperature and pressure requirements of the system in which installed.

C. Soldered Joints: Use ASTM B813, water-flushable, lead-free flux; ASTM B32, lead-free-alloy solder; and ASTM B828 procedure, unless otherwise indicated

3.5 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 23 0523

SECTION 23 0529 – HANGERS & SUPPORTS FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: The contractor shall design trapeze pipe hangers and equipment supports, using performance requirements and design criteria indicated. Trapeze hangars and equipment supports may be designed using recognized, catalogued, pre-engineered methods. Follow all means and methods identified on the support system product data.

B. Hangers and supports for equipment and distribution systems shall withstand the effects of gravity loads and stresses within limits and under conditions indicated.

1. Supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Hangers and supports shall withstand the effects of Wind and Seismic forces as required in Section 23 0548 “Seismic and Vibration Controls for Mechanical Systems.”

1.4 SUBMITTALS

A. Product Data: Provide sufficient information to show the hangars and supports are suitable for the intended purpose, including design loads and actual loads. Provide submittal data for:

1. Mechanical systems and equipment hangers and supports
2. Thermal-hanger shield inserts
3. Devices for attachment to the structure
4. Powder-actuated fastener systems
5. Recognized, catalogued, pre-engineered hangar and support systems.

B. Seismic Control Data: Submit all required information by the Delegated Design Professional in responsible charge of design for Seismic Controls for this project. Where Section 23 0548 “Wind, Seismic, and Vibration Controls for Mechanical Systems” does not indicate any required seismic controls, no such submittal is required.

C. Wind Resistance Data: For all systems and equipment installed outdoors, submit shop drawings indicating the design of the supports and curbs, the attachments to supports and curbs, and the attachment of the support and curbs to the structure, slab, or grade as required to provide resistance to the wind forces identified in Section 23 0548 “Wind, Seismic, and Vibration Controls for Mechanical Systems.” Where there is no product of this section installed outdoors, no such submittal is required.

D. Shop Drawings: Provide fabrication and installation details, calculations stamped by a Registered Professional Engineer, and Product Data for the following systems:

1. Trapeze pipe, duct hangers, multi-trade support racks, and equipment supports not addressed by recognized, catalogued, pre-engineered methods.
2. Architect/Engineer Responsibilities: The Architect/Engineer shall review delegated design submittals for compliance with specification requirements. Design and analysis performed for the delegated design submittal will not be reviewed.

E. Welding Certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code.

PART 2 - PRODUCTS

2.1 PIPE HANGERS

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. B-Line Systems, Inc.; a division of Cooper Industries
3. nVent Caddy
4. PHD Manufacturing, Inc.
5. Tolco/Eaton

C. Galvanized, Metallic Coatings: Pre-galvanized 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.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, 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.

2.3 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries
2. nVent Caddy
3. PHD Manufacturing, Inc
4. Power-Strut Div.; Tyco International, Ltd.
5. Tolco/Eaton
6. Unistrut Corp.; Tyco International, Ltd.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig (690 kPa) 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 or ASTM C 552, Type II cellular glass.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. Hilti, Inc.
b. ITW Ramset/Red Head
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC
e. Powers Fasteners
f. PHD Manufacturing, Inc.

2.6 PIPE STAND FABRICATION

A. Pipe Stands, General: Pre-engineered, manufactured assemblies made of manufactured corrosion-resistant components to support roof-mounted piping, where it is acceptable to rest by gravity on the roof membrane or ballast.

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. ERICO/Michigan Hanger Co.
b. MIRO Industries

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

1. Manufacturer: 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. ERICO/Michigan Hanger Co.
b. MIRO Industries
c. Portable Pipe Hangers

2. Bases: Plastic.

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. Manufacturer: 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: Where required for wind or seismic resistance, or where required to be attached to the roof deck. Shop-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers/guides/clevis as required for mounting on permanent stationary roof curbs or rails which are attached to the roof deck.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 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, non-shrink and non-metallic grout; suitable for interior and exterior applications.

1. Properties: Non-staining, non-corrosive, and non-gaseous.
2. Design Mix: 5000-psi (34.5-MPa), 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-58 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.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-58 and MSS SP-89 for the installation of hangers, supports, clamps, and attachments to properly support piping from building structure.

B. Hanger Spacing:

1. Hanger spacing and sizing shall per MSS SP-58 or applicable codes, whichever is more stringent.
2. Hanger spacing must be reduced to compensate for any valves and/or fittings installed in the pipe run.
3. Alternate span calculations may be used with a maximum deflection of 0.1 inch (2.5 mm) between hangers.
4. Hanger spacing must be reduced if thermal hanger shield insert cannot support full span.

C. Channel Support or Steel Trapeze System Installation:

1. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
2. Multiple pipe runs may be supported on channel/steel trapeze support systems with rollers. Support systems shall be individually designed by a structural engineer with the exception of the following:

   a. For pipe configurations specified in Table 1, channel support system hangers shall be as described below. Channel support shall be Unistrut P-1000. Hanger rods shall be one size larger than MSS SP-58 requires for largest pipe on support. Where support length exceeds 42 inches (1050 mm), additional hanger rod shall be installed at mid-span and pipe quantities in Table 1 may be placed on each side. Rollers shall be Unistrut P2474 through 6 inches, or P2475 through 16 inches; equal by Anvil or B-Line. Maximum number of pipes on one 42-inch (1050 mm) P-1000 channel support is:

Table 1	
Largest Pipe Size	Maximum No. Pipes
NPS 5 and larger	0
NPS 4	2
NPS 3	3
NPS 2-1/2	5
NPS 2	8
NPS 1-1/2	12
NPS 1-1/4 and smaller	16

D. Hanger and Support Installation:

1. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
2. 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.
3. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
4. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31 is not exceeded.
5. Comply with the following for insulated piping:

    a. Attach clamps and spacers to piping.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Generator exhaust piping: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    d. Do not exceed pipe stress limits according to ASME B31.1.
    e. Provide protection shields at all pipe supports. Metal shield lengths shall be as required by MSS-SP58 for the compressive strength and support span. Manufactured units shall include certification of compliance with MSS-SP58 for intended use. Requirements shall be as follows:

        1) Insulated piping up to NPS 1-1/2 (DN40) - MSS Type 40 insulation protection shields without high-density inserts.
        2) Insulated piping NPS 2 (DN50) and larger - MSS Type 40 thermal-hanger shield assemblies with the high-density inserts having the same thickness as piping insulation.

E. Building Attachments:

1. Review structural drawings for details of methods of attachment. Coordinate support requirements with project structural engineer.
2. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length specified herein or as indicated in MSS SP 58. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, 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.
3. Install powder-actuated drive-pin fasteners 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.
4. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
5. Attachments to bar joists shall be at panel points and shall comply with load limits and other requirements of the Structural Engineer.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.

B. Fit exposed connections together to form hairline joints. Connections shall be welded.

3.5 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touching 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.

B. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (.05 mm).

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.3.1.

1. Galvanizing repair paints and coatings used within buildings shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

END OF SECTION 23 0529

SECTION 23 0548 – WIND, SEISMIC, AND VIBRATION CONTROLS FOR MECHANICAL WORK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section. Additional seismic criteria may be specified in individual sections.

B. Work of this section shall be applied to all Division 23 specifications and drawings.

1.2 SUMMARY

A. This Section includes the vibration and acoustic isolation devices, wind and seismic restraint delegated design criteria, wind and seismic system performance criteria and wind and seismic for Division 23 Mechanical systems and components. The work shall conform to the 2018 International Building Code. The requirements of this specification may exceed the requirements of these codes.

B. The work in this section includes, but is not limited to, the following:

1. Conventional and seismic vibration isolation for piping, ductwork, conduit, raceways, and equipment.
2. Seismic restraints for non-isolated equipment.
3. Wind restraints for non-isolated equipment and components.
4. Certification of seismic designs and installation supervision.
5. Certification of attachment and reinforcement of housekeeping pads.
6. All equipment requiring International Building Code compliance.
7. All inspection and test procedures for systems and components requiring International Building Code compliance
8. Systems referred to below are typical. (Equipment not listed is still included in this specification.) All Mechanical systems that are part of the building in any way are referred to as systems or components and must comply with this specification, including:

Curbs	Flues and Breeching	Risers
Ductwork and Accessories	Boilers	Temperature Controls
Equipment Supports	Pipe	Variable Frequency Drives
Hangers and Supports	Pumps (all types)	Vibration Isolators
Fans (all types)		

1.3 DEFINITIONS

A. Essential Facilities: Buildings and other structures classified as Occupancy Category IV that are intended to remain operational in the event of extreme environmental loading from earthquakes.

B. Hazardous Materials: Those chemicals that are physical hazards or health hazards as defined in International Building Code, Section 307, the International Fire Code, and 29 CFR 1910.1200, Appendix A, whether the materials are in usable or waste condition.

C. Highly Toxic Materials: A material which produces a lethal dose or lethal concentration that falls within any of the highly toxic materials categories defined in the International Building Code, Section 307.1 and 29 CFR 1910.1200, Appendix A.

D. Life Safety: All systems involved with, but not limited to, fire protection including sprinkler piping, jockey pumps, fire pumps, control panels, service water supply piping, water tanks, fire dampers, smoke exhaust systems, communications and fire alarm panels intended for the prevention of loss of life.

E. Licensed Professional Engineer: The individual(s) providing the delegated design shall be licensed by the state in which the project is to be constructed to practice engineering within that state.

1.4 GENERAL DESIGN AND PERFORMANCE REQUIREMENTS

A. Design Parameters:

1. Seismic Design Criteria:

a. Seismic Design Parameters:

1) Risk Category: III
2) Site Class: C
3) Mapped Spectral Response Acceleration at Short Period (S_S): 1.307
4) Design Spectral Response Acceleration at Short Period (S_{DS}): 1.045
5) Mapped Spectral Response Acceleration at 1-Second Period (S_1): 0.484
6) Design Spectral Response Acceleration at 1-Second Period (S_{D1}): 0.484
7) Seismic Design Category: D.

b. Designated Seismic Systems: The following Division 23 systems are Designated Seismic Systems as defined by Chapter 17 of the International Building Code and have a Component Importance Factor of 1.5. Refer to other Divisions for designation of respective systems. The systems and components shall remain in-place, structurally intact, and operational after a design seismic event. Certificates of compliance are required for all designated seismic systems.

1) Life Safety:

a) Fire dampers, smoke dampers and combination fire smoke dampers
b) Smoke management systems

2) Systems Containing Hazardous Materials or Highly Toxic Materials:

a) Fuel oil systems
b) Fuel gas piping systems

3) Essential Systems:

a) All systems in entire building.
b) Mechanical systems serving entire building

2. Wind Design Criteria:

a. Design wind speed (3-second gust): 109 mph
b. Wind Importance Factor *(Iw)*: 1.0
c. Exposure Category: C

B. General Design and Performance Requirements:

1. All equipment, piping, and ductwork, conduit, and raceways shall be seismically braced or restrained and shall comply with the 2018 International Building Code, Section 1613, Earthquake Loads. Reference herein to the requirements of the International Building Code shall include the requirements of ASCE 7-10, Chapter 13, where incorporated by reference in the International Building Code. Where seismic restraint is required, vibration control shall apply as specified.
2. All outdoor equipment, including roof mounted components shall comply with the International Building Code, Section 1609, Wind Loads. Reference herein to the requirements of the International Building Code shall include the requirements of ASCE 7-10, Chapters 6, where incorporated by reference in the International Building Code.
3. Wind and seismic bracing and isolation materials in one specification division shall be the products of the same manufacturing group where available and shall be certified by that group or an independent testing agency approved by the Authority Having Jurisdiction.
4. All Mechanical building system components shall remain in place during wind and seismic events and additionally shall remain operational where specified.
5. Wind and Seismic Load Certification and Analysis:

a. Calculations by the qualified licensed professional engineer substantiating the mounting system, wind and seismic restraints and recommended anchor bolts shall be submitted with the shop drawings as a part of the required submittals. Wind and seismic loads shall have their calculations based on criteria as established in this specification. All analysis shall be stamped by a licensed professional engineer.
b. Restraints shall maintain equipment, piping, conduit and ductwork in a captive position. Mechanical restraint devices shall be designed and selected to meet wind and seismic requirements as defined in the International Building Code, Chapters 16 and 17.
c. For projects that contain life safety, high hazard, and essential Mechanical components, provide certification of compliance and submit special inspections reports as required by the International Building Code.

Where compliance is not possible, each contractor shall submit a report (Example Form 1, "Seismic Qualification of Mechanical Components" at end of this specification) to the Authorities Having Jurisdiction and as a required submittal clearly indicating that none of the specified, listed, or other suppliers' equipment known to the Contractor meet the compliance, testing and certification portions of

the International Building Code, Section 16 and 17. Special inspections of the equipment installation shall still be conducted.

d. All equipment (components) shall be secured to the structure in accordance with the code. All component manufacturers will submit shop drawings that include the following:

1) The manufacturer of all Mechanical life safety equipment, high hazard equipment, and essential equipment shall submit the Certificate of Compliance. Where components not defined as Designated Seismic Systems could affect the performance of other Designated Seismic Systems should they dislodge or fail, anchorage of that component shall require compliance.

a) Essential components include all components needed for continued operation of the facility. These components shall be certified that the mounting system will remain intact, the component shall remain structurally intact and the component shall remain operable following a design seismic event.

b) Components containing hazardous or flammable materials shall be certified that the component will maintain containment following a design seismic event.

e. For all components requiring anchorage compliance only, the licensed professional engineer shall submit a calculation package stamped by the engineer demonstrating that their project specific equipment will accept anchorage through the component's load path to structure at its center of gravity at the designated anchorage locations.

6. Wind and Seismic Anchorage:

a. Analysis for anchorage must indicate calculated dead loads, wind and seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bold diameter, embedment and/or welded length. All wind and seismic restraint devices shall be designed to accept, without failure, the forces detailed in this section, acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

b. In the event that the equipment is internally isolated and restrained, the entire unit assembly must be attached to the structure to withstand wind and seismic loads. Curb or roof rail mounted equipment must not only have wind and seismic attachment of the equipment to the roof but also to the curb or rails. The attachment and certification thereof shall be by this section. Sheet metal screw attachment is acceptable provided that the following three conditions are met and verified.

1) Calculations support sufficient quantity and size of sheet metal screws to handle all loads including shear.

2) Space or gap between the inside overhang of the rooftop unit and the curb at each of the screw locations is closed with structural material, tapered to contour to both the curb and the components' inside edge structure. Life Safety, High Hazard, and Occupancy Category IV Components.

3) The method of attachment does not violate the NRCA rating of the curb by violating the roof's member waterproofing.

1.5 SUBMITTALS

A. Delegated-Design Submittal: Vibration isolation, wind, and seismic-restraint details shall comply with performance requirements and design criteria. Analysis data shall be signed and sealed by the qualified licensed professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, wind and seismic forces required to select vibration isolators, wind and seismic restraints, and for designing vibration isolation bases.
2. Wind and Seismic-Restraint Details:

a. Design Analysis: To support selection and arrangement of wind and 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 spacing. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during wind and seismic events. Indicate association with vibration isolation devices.
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) shall be submitted.

3. Architect/Engineer Responsibilities: The Architect/Engineer shall review delegated design submittals for compliance with specification requirements. Design and analysis performed by the Engineer-in-Responsible Charge of the delegated design submittal will not be reviewed.

B. Product Data:

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. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

C. Schedules:

1. Detailed schedules of flexibly and rigidly mounted equipment for wind and seismic and components, showing vibration isolators and restraints by referencing numbered descriptive drawings.
2. Those systems and components identified as Designated Seismic Systems requiring special inspection with frequency of inspection.

D. Shop Drawings:

1. Fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
2. Details of suspension and support for ceiling hung equipment.
3. Attachment methods for ducts, pipe, conduits and raceways to floors, slabs or supplementary steel work. Restraint manufacturer's submittals must include spacing, and maximum static loads and wind and seismic loads at all attachment and support points.
4. Specific details of restraints and anchors; include number, size and locations for each piece of equipment.

E. Quality Assurance/Control Submittals:

1. Calculations shall be submitted for all restraints and anchorages.
2. "Seismic Qualification of Mechanical Components" (Example Form 1 located at end of section).
3. "Statement of Contractor Responsibility for Designated Seismic Systems and Mechanical Components Requiring Special Inspection" (Example Form 2 located at end of section).
4. "Quality Assurance Plan for Seismic Resistance" (Example Form 3 located at end of section).

F. Certificates:

1. A seismic design Errors and Omissions insurance certificate must accompany the seismic restraint equipment manufacturer's certification. Product liability insurance certificates must also be provided for all products supplied by the isolation and seismic restraint vendor.
2. Certificates of Compliance for all Designated Seismic Systems.

G. Welding: Procedures and welder certificates

1.6 QUALITY ASSURANCE

A. Quality Assurance Plan:

1. A quality assurance plan for seismic requirements shall be provided in accordance with the International Building Code, Section 1705.3 for the following:

   a. Designated seismic systems.
   b. The following additional systems:

      1) Heating, ventilating and air-conditioning (HVAC) ductwork containing hazardous materials and anchorage of such ductwork.
      2) Piping systems and Mechanical units containing flammable, combustible or highly toxic materials.

B. Contractor Responsibilities and Approvals: Each contractor responsible for the installation of seismic components requiring special inspection shall be responsible for submitting a written contractor's Statement of Responsibility to the Authority Having Jurisdiction and the Architect/

Engineer. (Refer to Example Form 2, "Statement of Contractor Responsibility for Designated Seismic Systems and Mechanical Components Requiring Special Inspection" at end of specification.)

C. Periodic and Component Special Inspection

1. The following systems shall require Periodic Special Inspection or Component Periodic Special Inspection for seismic installation and anchorage during the course of construction.

   a. Periodic special inspections during installation of piping systems intended to carry flammable, combustible or highly toxic contents and their associated Mechanical units.
   b. Periodic special inspections during the installation of HVAC ductwork that will contain hazardous materials.
   c. Special inspection for the installation of the following components, where the component has a Component Importance Factor of 1.0 or 1.5 in accordance with Section 9.6.1.5 of ASCE 7, shall maintain an approved quality control program. Evidence of the quality control program shall be permanently identified on each piece of equipment by a label.

      1) Equipment using combustible energy sources.
      2) Electrical motors, transformers, switchgear unit substations and motor control centers.
      3) Reciprocating and rotating-type machinery.
      4) Piping distribution systems 3 inches and larger.
      5) Tanks, heat exchangers and pressure vessels.

   d. Periodic special inspection is required during the installation of vibration isolation systems where the construction documents require a nominal clearance of 1/4 inch or less between the equipment support frame and restraint.
   e. Seismic systems requiring seismic qualification in accordance with Section 1705.12.6 and verify that the label, anchorage or mounting conforms to the certificate of compliance.

2. The Engineer in Responsible Charge of the Delegated Design of each of the components and systems shall prepare a "Statement of Special Inspections" (refer to example form 3 at end of specification) per 2018 International Building Code Section 1705 and submit to the Authorities Having Jurisdiction and Architect/Engineer.

D. Manufacturer of restrained vibration isolation, wind, and seismic load control equipment shall have the following responsibilities:

1. Determine vibration isolation and restraint sizes and locations.
2. Provide vibration isolation and restraints.
3. Provide calculations and materials if required for restraint of non-isolated equipment.
4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

E. All equipment of a particular category, i.e. seismic restraints, vibration isolators, flexible connectors, shall be of the same manufacturer and shall be selected using published or certified data.

F. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel" for all non-ASME Code welding.

PART 2 – PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kinetics Noise Control
2. Mason Industries
3. Vibration Mounting Systems (VMC, Amber/Booth Company, and Korfund Dynamics

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to Authorities Having Jurisdiction.

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: All-directional seismic snubbers shall consist of interlocking steel members restrained by an elastomeric bushing of Durulene(TM) Bushing shall be replaceable and a minimum of 1/4 inch thick.

1. Rated loading shall not exceed 1000 psi. A minimum air gap of 1/8 inch shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances.
2. Elastomeric bushings shall be rotated to insure no short circuits exist before systems are activated.
3. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in and stud-wedge or female-wedge type.

D. 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.

E. Restraint Cables: 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.

F. Rigid Braces: Seismic rigid braces shall consist of ASTM A-36 steel angles or channels to resist seismic loads. Seismic solid brace end connectors shall be steel assemblies that swivel to the final attachment angle and utilize two through bolts to provide proper attachment, spaced to IBC standards for attachment to concrete or steel.

G. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

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 dry interior applications and stainless steel for exterior and wet interior 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 dry interior applications and stainless steel for exterior and wet interior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and wind 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 Pipe Supports: Secure pipes 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 installation Shop 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 VIBRATION-CONTROL WIND AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install seismic snubbers on Mechanical equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an agency acceptable to Authorities Having Jurisdiction and in accordance with delegated design submittals.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127 and NFPA 13.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between mounting holes and anchor bolts in concrete base.

F. 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.

G. 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 as approved by structural engineer.

H. 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 pre-stressed 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 dry interior and stainless-steel anchors for exterior and wet interior applications.

3.4 FIELD QUALITY CONTROL

A. Inspections:

1. Measure isolator restraint clearance.
2. Measure isolator deflection.
3. Verify snubber minimum clearances.
4. Engage the services of a Special Inspector qualified under Chapter 17 of the International Building Code to perform the special inspections related to seismic and wind as required in Chapter 17 of the IBC for mechanical systems.

B. Adjusting:

1. Adjust isolators after piping system is at operating weight.
2. 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.
3. Adjust active height of spring isolators.
4. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 23 0548

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FORM 1
SEISMIC QUALIFICATION OF MECHANICAL COMPONENTS

CONTRACTOR NAME: _____

DATE: _____

PROJECT: _____

The Mechanical designated seismic systems requiring certification per 2018 International Building Code Section 1705 and/or ASCE 7-10, Section 13.2.2 are listed below. The items listed as not certified are not compliant and no equivalent product is available to the best of the Contractor's knowledge.

Specification Section	Equipment Item	Service*	Certified

* Enter LS for life safety service, HZ for hazardous service, or ES for essential service

Signature:_____

Date:_____

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FORM 2
STATEMENT OF CONTRACTOR RESPONSIBILITY
FOR DESIGNATED SEISMIC SYSTEMS AND
MECHANICAL COMPONENTS REQUIRING SPECIAL INSPECTION

CONTRACTOR NAME: _____

DATE: _____

PROJECT: _____

SPECIFICATION SECTIONS: _____

Attached is our Statement of Responsibility containing the following information required by the 2018 International Building Code, Section 1706.

1. Acknowledgment of awareness of the special requirements contained in the statement of special inspections;

2. Acknowledgment that control will be exercised to obtain conformance with the construction documents approved by the building official;

3. Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of the reports; and

4. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.

Signature:_____

Date:_____

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FORM 3
STATEMENT OF SPECIAL INSPECTIONS

LICENSED PROFESSIONAL ENGINEER: _____

DATE: _____

PROJECT: _____

The quality assurance plan below lists the designated seismic systems or other qualifying HVAC systems stated in the 2018 International Building Code section 1705 requiring special inspections.

SEISMIC SYSTEM	REQUIRED VERIFICATION AND INSPECTION	FREQUENCY OF SPECIAL INSPECTION	FREQUENCY AND DISTRIBUTION OF SPECIAL INSPECTION REPORTS	APPLICABLE REFERENCE STANDARDS

_____
Signature

Seal

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SECTION 23 0700 – MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

1.2 DEFINITIONS

A. The word "concealed" as used in this section refers to insulation in ceiling plenums, furred spaces, pipe and duct shafts, unheated spaces immediately below roof and crawl spaces. The word "exposed" refers to insulation in other areas.

1.3 SYSTEM DESCRIPTION

A. Systems to be Insulated: Insulate portions of the following systems, equipment, and accessories, except where noted otherwise or furnished by OEM as part of equipment.

1. Cold Piping Systems:

    a. HVAC chilled water piping (including brine systems)
    b. Tower water - supply and return to hydronic free cooling heat exchangers
    c. Refrigerant suction lines and accessories
    d. Heat trace piping
    e. Piping and cold surfaces (valve bodies, etc.) inside unit ventilators, air handling units, unitary air conditioning units, and terminal heating and cooling units
    f. Exposed cooling coil headers and manifolds
    g. Condensate drain pans (unless pre-insulated)
    h. Fittings, valves, strainers, and check valves

2. Ductwork and Breeching:

    a. Exposed ductwork where noted

3. Items that need not be insulated:

    a. Exposed ductwork in occupied spaces (unless otherwise noted)
    b. HVAC return ductwork in return air plenums (unless otherwise noted)

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, permeability, thickness, and jackets (both factory and field applied, if any). Submit a schedule showing on one

document, each mechanical system or component to be insulated, and the product to be used on each system/component.

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger
2. Detail attachment and covering of heat tracing inside insulation
3. Detail insulation application at 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
7. Detail application at linkages of control devices
8. Detail field application for each equipment type

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Protect insulation against dirt, water, chemical, or mechanical damage before, during, and after installation. Satisfactorily repair or replace any such insulation or covering damaged prior to final acceptance of the work.

B. 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 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork shop drawings, establish and maintain

clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 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 PIPE INSULATION

A. Manufacturers:

1. Armstrong World Industries
2. Certainteed Crimpwrap
3. Fibrex Insulations Inc.; Coreplus 1200
4. Knauf Insulation; 1000 Pipe Insulation
5. Manson Insulation Inc.; Alley-K
6. Owens Corning; Fiberglas Pipe Insulation
7. Johns Manville; Micro-Lok

B. Preformed fiberglass conforming to ASHRAE 90.1-2004, ASTM C547, Class I or II, and ASTM C585 with "K" factor of 0.23 Btu-in./h-sf-°F maximum at 75°F mean temperature. See schedule for thickness.

C. Provide factory-applied ASJ/SSL type, ASTM C921, or ASTM C1136, Type I jacket with vapor barrier for cold piping (below ambient), or Type II for hot piping (above ambient). Type I may be used for both at Contractor's option. Factory-applied flap adhesive (SSL) or conventional staple and tape seal at Contractor's option.

D. Pipe Insulation Thickness Schedule:

Piping System Type		Minimum Insulation Thickness for Pipe Sizes				
	From:		**NPS 1**	**NPS 1-1/2**	**NPS 4**	**Greater than NPS 8**
	To less than:	**NPS 1**	**NPS 1-1/2**	**NPS 4**	**NPS 8**	
1. Chilled water supply and return (above 40°F)		1-1/2”	1-1/2”	1-1/2”	1-1/2”	1-1/2”
2. Chilled water supply and return (below 40°F)		1-1/2”	1-1/2”	1-1/2”	1-1/2”	1-1/2”
3. Refrigerant suction		1-1/2”	1-1/2”	1-1/2”	1-1/2	N/A

Note: For piping exposed to outdoor ambient temperatures, increase thickness by 0.5 in.

E. Cover fittings and valves with pre-molded one-piece PVC-insulated covers. This product is not to be installed in locations where its use is prohibited by local codes.

F. Protect insulation on exterior piping exposed to the weather with weatherproof metal jacket. Provide jacket with 0.016-inch-thick aluminum, with laminated vapor barrier. Provide "Z" groove in jacket to assure watertight seal. Seal each joint with snap straps containing permanently plastic sealing compound and secured by 1/2-inch-wide stainless steel bands.

2.2 DUCT INSULATION

A. Specification “A”: 1-1/2-inch-thick fiberglass 3/4 lbs/ft^3. density blanket with factory-applied heavy duty FSK facing with a "K" value of 0.28 Btu-in./h-sf-°F maximum at 75°F mean temperature.

B. Specification “B”: 1-1/2-inch-thick , 3.0 lbs/ft^3 density fiberglass insulation board. Provide preformed, flat, rectangular, rigid insulation with "K" value of 0.22 Btu-in./h-sf-°F maximum at 75°F mean temperature.

C. Specification “C”: 2-inch-thick , 3.0 lbs/ft^3 density fiberglass insulation board equal to CSG Group with factory-applied FSK vapor barrier facing. Provide preformed, flat, rectangular, rigid insulation with a "K" value of 0.22 Btu-in./h-sf-°F maximum at 75°F mean temperature.

D. Specification “D”: 3-inch-thick calcium silicate, ASTM C534, Type I.

E. Specification “E”: 2-inch-thick foil-encapsulated, non-asbestos, high temperature, low biopersistence, flexible fireproofing wrap. Use in combination with 3M Fire Barrier 1000 N/S Silicone sealant. Provide 3M Fire Master Fast Wrap + to provide a two hour fire resistant rated enclosure or equal. Provide wrap rated to protect combustible construction at zero clearance at the overlap points. Comply with ASTM E84, UL 723, and NFPA 96.

F. Specification “F”: 2-inch-thick closed cell elastomeric insulation meeting the requirements of ASTM C 534 with a 12-mil laminated covering. Insulation shall have a maximum thermal

conductivity of 0.27 Btu-in./h-ft2- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions, and shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision. Armaflex, with Armaflex tape sealed joints. Slope top surface in accordance with manufacturer's instructions.

G. Specification “L” and “R”: See Duct Liner specification below for material and liner thickness.

H. Duct Insulation and Lining Schedule:

System	Insulation Spec	Thickness	Vapor Seal Required
1. HVAC supply - concealed	L	1"	No
2. HVAC return - concealed	None		

**UL YYET listing not required on type II duct. Approval from Authority Having Jurisdiction must be obtained prior to application of specification “E” fireproofing wrap.*

***Other than kitchen exhausts.*

2.3 DUCT LINER

A. General:

1. Comply with requirements of NFPA 90A and 90B, UL 181 Class 1, ASTM C1071, and the Materials Standard of the North American Insulation Manufacturer's Association (NAIMA); Type 200, Flame Spread 25 maximum and Smoke Development 50 maximum.
2. Absorption: Not more than 1% moisture when tested per ASTM C553.
3. Corrosion: Shall not cause corrosion of duct material (aluminum or galvanized steel) when tested per ASTM C665.
4. Microbial Growth: None when tested per ASTM C665, G-21, and G-22. Include an EPA-registered anti-microbial agent in coating.
5. Coating: Coat air-stream surface and transverse edge with a factory-coated tough composite material to provide a maximum average velocity rating of 5,000 fpm or better at 250°F when tested per ASTM C1071.
6. Thermal Resistance: "K" value of 0.27 Btu-in./h-sf-°For less (1-inch thickness, 1 lb/ft^3) when tested per ASTM C518 at 75°F mean temperature.
7. Sound Absorption: Sound absorption coefficient (1-inch thickness, 1 lb/ft^3) of 0.72 or higher at 1,000 Hz when tested per ASTM C423, Type A mounting. Round duct liner shall have a Noise Reduction Coefficient (NRC) of 0.70 or better when tested per ASTM C423, Type A mounting.

B. Rectangular Liner, Specification "L": Approved manufacturers are CertainTeed (ToughGard), Knauf type E-M, Owens-Corning (Aeroflex), and Johns-Manville (Permacote Linacoustic).

1. Duct sizes shown on drawings are clear internal dimensions and do not include liner.

C. Round Liner, Specification "R":

1. Approved Manufacturers: Johns-Manville (Spiracoustic Plus).

2. Round Duct Liner:

a. Use "Spiracoustic Plus" slip-in or snap-in fiberglass duct board with airstream surface Permacote coating or Engineer-approved equal.
b. Install liner in both straight duct and fittings per manufacturer's recommendations. Fill and seal all gaps and tears or abrasions per manufacturer's recommendations. Coat edges exposed to the air-stream with Superseal HV sealant or Engineer-approved equal.
c. Duct sizes shown on drawings are clear INTERNAL dimensions, increase shell diameter accordingly.

D. Provide materials compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

E. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800°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, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. 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 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, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic

Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

G. 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, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.4 MASTICS

A. Provide materials compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use adhesive that has 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 at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180°F.
4. Solids Content: ASTM D 1644, 58% by volume and 70% 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, CP-30 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°F.
4. Solids Content: ASTM D 1644, 33% by volume and 46% 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.
3. Service Temperature Range: Minus 20 to plus 180°F.
4. Solids Content: 60% by volume and 66% by weight.
5. 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 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°F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl and PVC 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.

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°F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 INSTALLERS

A. Install insulation with workers regularly engaged in this kind of work in strict accordance with the manufacturer's recommendations and recognized industry practices.

3.2 INSTALLATION

A. General:

1. Apply full-length units of insulation on clean, dry surfaces free of foreign matter. Apply only after tests and approvals required by the specifications have been completed.
2. Apply insulation on cold surfaces with a continuous, unbroken vapor seal. Provide insulation and vapor seal at supports, anchors, etc., that are secured directly to cold surfaces to prevent condensation.
3. Finish raw edges with finishing cement.

B. Pipe Insulation:

1. Insulate pipe continuously through walls and floor openings except where walls and floors are required to be fire-stopped or required to have a fire-resistance rating. Where this occurs, fill the open space remaining between the sleeve and pipe with fire-stop.
2. Butt joints firmly together and smoothly, secure self-sealing jacket laps and joint strips with monel staples at 6-inch o.c. and cover with lap adhesive or factory (SSL) adhesive.
3. Seal ends of cold pipe insulation with a vapor barrier coating at fittings and valves and at intervals of 21 feet on continuous runs of pipe.
4. Insulate cold pipes continuously through hangers. Provide rigid insulation inserts at pipe hangers and supports per Division 23 Section "Hangers and Supports for HVAC Systems." Abut pipe insulation to the rigid insulation insert. Apply a wet coat of vapor barrier lap cement on butt joints and seal the joints with 3-inch-wide vapor barrier tape or band. Coat staples with heavy coat of brushed on vapor barrier lap cement.

C. Insulation on Fittings and Valves:

1. Where the factory pre-molded one-piece PVC insulated fitting covers are to be used, apply the proper factory precut insulation to the fitting using two layers for pipe temperatures above 250°F or below 35°F, single layer insulation is suitable between 35°F and 250°F. Tuck the ends of the insulation snugly into the throat of the fitting with the edges adjacent to the pipe covering, tufted and tucked in, fully insulating the pipe fitting. Overlap the covers to adjoining pipe insulation and jackets and seal all cold pipes at seam edges with vapor barrier adhesive. Seal the circumferential edges of covers with pressure sensitive tape. Overlap the tape on the jacket and the cover at least 1 inch .
2. At locations where the PVC covers are prohibited, use as an alternate one of the following methods: one-coat insulation cement, pre-molded fiberglass fitting covers, or mitered segments of pipe insulation. Provide glass fabric embedded in fire-retardant mastic finish. Use vapor barrier mastic for cold piping for cold piping.
3. Insulate valves with sections of fiberglass pipe insulation complete with all service jackets. Coat raw ends with vinyl acrylic mastic for hot piping or vapor barrier mastic for cold piping.

D. Blanket Insulation:

1. Apply insulation with edges tightly butted with facing overlapping joints at least 2 inches. Where vapor seal is required, seal the joints with fire-retardant adhesive. Secure the insulation to the duct with approximately 4-inch-wide strips at 8 inch o.c. of fire-retardant adhesive. Where the duct width exceeds 30 inches, attach the underside insulation with mechanical fasteners on about 18-inch maximum centers.
2. Where vapor seal is required, seal breaks and punctures with vapor barrier tape and fire-retardant adhesive.

E. Board Insulation:

1. Apply insulation with edges tightly butted and fastened to duct with mechanical fasteners spaced on 12-inch to 18-inch centers or as required to hold insulation firmly against the duct surface. Tightly secure insulation in place with washers.
2. Where vapor seal is not required, apply a tack coat of a fire-retardant adhesive; embed into wet tack coat glass cloth. Smooth membrane to avoid wrinkles and overlap seams at least 2 inches. Apply finish coat of fire-retardant adhesive in sufficient thickness to completely cover glass cloth.
3. Where vapor seal is required, seal joints, breaks, and punctures in facing with fire-retardant vapor barrier adhesive and place a 3-inch-wide tape similar to that of the facing material over adhesive.

F. Duct Liner:

1. For velocities up to 2000 fpm , apply duct liner with 100% coverage of fire-retardant adhesive. Cut duct liner to assure snug corner joints. Face the coated or most dense surface of the liner to the airstream. Additionally secure the duct liner with mechanical fasteners that compress the duct liner sufficiently to hold it firmly in place. Start the fasteners within 3 inches of the leading edge of each duct section (and line transverse joints within the duct section) and space no more than 12 inch o.c. around the perimeter of the

duct, except that they need to be no closer than 9 inches to a corner break. Elsewhere, secure at a maximum of 18 inch o.c., except place not more than 6 inches from a cut edge, nor 12 inches from a corner break. Coat exposed edges and the leading edge of cross joints of the liner with the same adhesive used to secure the duct liner to the metal surface.

2. For velocities between 2000 to 5000 fpm , install liner as described above except space the mechanical fasteners no more than 6-inch o.c. around the perimeter of the duct, and no closer than 6 inches to a corner break. Elsewhere, secure at a maximum of 10-inch o.c., except not more than 6 inches from a cut edge or 12 inches from a corner break. Install metal nosing to protect leading edges.
3. Install liner in both straight duct and fittings per manufacturer's recommendations. Fill gaps and tears or abrasions per manufacturer's recommendations. Coat edges exposed to the airstream with Superseal HV sealant or Engineer-approved equal.

G. Other Requirements:

1. Provide removable insulation sections to cover parts of equipment that must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames, and accessories.
2. Repair sections of mechanical insulation damaged during this construction period. Use insulation of same thickness as existing insulation; install new jacket lapping and seal over existing.
3. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

END OF SECTION 23 07 00

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SECTION 23 0800 - COMMISSIONING OF MECHANICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specifications, apply to this section.

B. The OPR and BOD documentation are included by reference for information only.

1.2 SUMMARY

A. This section includes commissioning process requirements for Mechanical systems, assemblies, and equipment.

1.3 DESCRIPTION

A. Refer to Division 01 Section “General Commissioning Requirements” for the description of commissioning.

1.4 DEFINITIONS

A. Refer to Division 01 Section “General Commissioning Requirements” for definitions.

1.5 SUBMITTALS

A. Refer to Division 01 Section “General Commissioning Requirements” for CxA’s role.

B. Refer to Division 01 Section “Submittals” for specific requirements. In addition, provide the following:

C. Certificates of readiness

D. Certificates of completion of installation, prestart, and startup activities.

E. O&M manuals

F. Test reports

1.6 QUALITY ASSURANCE

A. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer’s calibration procedures and intervals. Recalibrate test instruments immediately after instruments

have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

1.7 COORDINATION

A. Refer to Division 01 Section "General Commissioning Requirements" for requirements pertaining to coordination during the commissioning process.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standards testing equipment for the Mechanical system and controls system in Division 23, except for equipment specific to and used by TAB in their commissioning responsibilities. A sufficient quantity of two-way radios shall be provided by each subcontractor.

B. Special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the base bid price to the Owner and left on site, except for stand-alone data logging equipment that may be used by the CxA.

C. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.

D. Data logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the Owner.

E. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

PART 3 - EXECUTION

3.1 GENERAL DOCUMENTATION REQUIREMENTS

A. With assistance from the installing contractors, the CxA will prepare Pre-Functional Checklists for all commissioned components, equipment, and systems

B. Red-lined Drawings: The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings. The contracted party, as defined in the Contract Documents will create the as-built drawings.

C. Operation and Maintenance Data: Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems. The CxA will review the O&M literature once for conformance to project requirements. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the Contractor.

D. Demonstration and Training: Contractor will provide demonstration and training as required by the specifications. A complete training plan and schedule must be submitted by the contractor to the CxA four weeks (4) prior to any training. A training agenda for each training session must be submitted to the CxA one (1) week prior the training session

3.2 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meetings.

C. Attend testing, adjusting, and balancing review and coordination meetings.

D. Participate in Mechanical systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.

G. Prepare preliminary schedule for Mechanical system orientations and inspections, operation and maintenance manual submissions, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, testing and balancing and task completion for owner. Distribute preliminary schedule to commissioning team members.

H. Update schedule as required throughout the construction period.

I. Assist the CxA in all verification and functional performance tests.

J. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

K. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA 45 days after submittal acceptance.

L. Coordinate with the CxA to provide five (5) days advance notice so that the witnessing of equipment and system start-up and testing can begin.

M. Notify the CxA a minimum of two weeks in advance of the time for start of the testing and balancing work. Attend the initial testing and balancing meeting for review of the official testing and balancing procedures.

N. Participate in, and schedule vendors and contractors to participate in the training sessions.

O. Provide written notification to the CM/GC and CxA Authority that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.

1. Mechanical equipment including all fans, air handling units, ductwork, dampers, terminals, and all other equipment furnished under this Division.
2. Fire stopping in the fire rated construction, including fire and smoke damper installation, caulking, gasketing and sealing of smoke barriers.
3. Fire detection and smoke detection devices furnished under other divisions of the specification.
4. Building Automation System/ Control System
5. HTHW Generator
6. Stack Economizer
7. Piping, Valves, Tanks, etc.

P. The equipment supplier shall document the performance of his equipment.

Q. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.

R. Test, Adjust and Balance Contractor

1. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
2. Submit the site specific testing and balancing plan to the CxA and AE for review and acceptance.
3. Attend the testing and balancing review meeting scheduled by the CxA. Be prepared to discuss the procedures that shall be followed in testing, adjusting, and balancing the Mechanical system.
4. At the completion of the testing and balancing work, and the submittal of the final testing and balancing report, notify the Mechanical contractor and the CM/GC.
5. At the completion of testing and balancing work, and the submittal of the final testing and balancing report, notify the Mechanical Contractor and the CM/GC.
6. Participate in verification of the testing and balancing report, which will consist of repeating measurements contained in the testing and balancing reports. Assist in diagnostic purposes when directed.

S. Equipment Suppliers

1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner, to keep warranties in force.

2. Assist in equipment testing per agreements with contractors.
3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

T. Refer to Division 01 Section “General Commissioning Requirements” for additional contractor responsibilities.

3.3 OWNER’S RESPONSIBILITIES

A. Refer to Division 01 Section “General Commissioning Requirements” for Owner’s Responsibilities.

3.4 DESIGN PROFESSIONAL'S RESPONSIBILITIES

A. Refer to Division 01 Section “General Commissioning Requirements” for Design Professional’s Responsibilities.

3.5 CxA'S RESPONSIBILITIES

A. Refer to Division 01 Section “General Commissioning Requirements” for CxA’s Responsibilities.

3.6 TESTING PREPARATION

A. Certify in writing to the CxA that Mechanical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify in writing to the CxA that Mechanical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify in writing that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.7 TESTING, ADJUSTING AND BALANCING VERIFICATION

A. Prior to performance of Testing, Adjusting and Balancing work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least ten (10) days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of Mechanical systems at the direction of the CxA.

1. The CxA will notify testing and balancing subcontractor ten (10) days in advance of the date of field verification. Notice will not include data points to be verified.
2. The testing and balancing subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.8 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of Mechanical testing shall include entire Mechanical installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the Mechanical contractor, testing and balancing Subcontractor, and Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for Mechanical systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the Mechanical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.9 MECHANICAL SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 23 sections. Provide submittals, test data, inspector record, and certifications to the CxA.

B. &R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for Mechanical" and "Sequence of Operations for Mechanical Controls." Assist the CxA with preparation of testing plans.

C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment: Test requirements are specified in Division 23 piping Sections. Mechanical 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. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

E. Mechanical 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 Mechanical 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.

G. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and sub-systems. The following equipment and systems shall be evaluated:

1. Building Automation System
2. HTHW Generator
3. Chemical Treatment
4. Ductwork
5. Pumps
6. Piping
7. Testing, Adjusting and Balancing
8. Stack Economizer coil

3.10 DEFICIENCIES/NON-CONFORMANCE, COST OF RETESTING, FAILURE DUE TO MANUFACTURER DEFECT

A. Refer to Division 01 Section "General Commissioning Requirements" for requirements pertaining to deficiencies/non-conformance, cost of retesting, or failure due to manufacturer defect.

3.11 APPROVAL

A. Refer to Division 01 Section "General Commissioning Requirements" for approval procedures.

3.12 DEFERRED TESTING

A. Refer to Division 01 Section "General Commissioning Requirements" for requirements pertaining to deferred testing.

3.13 OPERATION AND MAINTENANCE MANUALS

A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in Division 01.

B. Refer to Division 01 Section "General Commissioning Requirements" for the AE and CxA roles in the Operation and Maintenance Manual contribution, review and approval process.

3.14 TRAINING OF OWNER PERSONNEL

A. Refer to Division 01 Section "General Commissioning Requirements" for requirements pertaining to training.

END OF SECTION 23 0800

SECTION 23 0801 – START-UP, TESTING & COMMISSIONING OF HVAC WITHOUT Cx AGENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

1.2 SUMMARY

A. This section covers the general requirements for the Division 23responsibilities for start-up, testing, and commissioning.

1. Mechanical system installation, start-up, testing, balancing, commissioning, preparation of O&M manuals, and operator training are the responsibility of the Contractor. Absence of a separate commissioning agent on this project does not relieve Division 23 from the obligations to complete all portions of the work in a satisfactory and fully operational manner.
2. Work of Division 23 includes:

   a. Testing and start-up of the equipment.
   b. Testing, adjusting, and balancing of hydronic and air systems.
   c. Providing qualified personnel for performance of start-up, testing, and commissioning tests.
   d. Providing equipment, materials, and labor as necessary to correct construction and/or equipment deficiencies found during the start-up, testing, and commissioning process.
   e. Providing operation and maintenance manuals and as-built drawings to the Owner.
   f. Providing system operating and maintenance procedure narratives.
   g. Providing training and demonstrations for the systems specified in this Division.

1.3 TRAINING

A. In addition to the requirements of Division 01, schedule and perform the training of the Owner's engineering and maintenance staff on each system and related components. Training will be conducted in a classroom setting, with field demonstrations as appropriate, with system and component documentation and suitable classroom training aids.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Provide test equipment as necessary for testing and start-up of the mechanical equipment and systems.

2.2 TEST EQUIPMENT - PROPRIETARY

A. Proprietary test equipment, hardware, and software required by the equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided at no cost. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Contractor in the start-up, testing, and commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the start-up, testing, and commissioning process.

B. Controls installer/manufacturer shall provide a printout of all software code and all User interface screens.

PART 3 - EXECUTION

3.1 WORK PRIOR TO DEMONSTRATION

A. Complete all phases of work so the systems can be started, tested, balanced, and commissioned. Contractor has primary start-up responsibilities for all mechanical systems so they are functional. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc.

B. A start-up, testing, and commissioning plan will be developed by the Contractor and submitted to the Owner. Owner or his representative may elect to observe stat-up testing and commissioning.

C. Responsibilities of Contractor are as follows:

1. Factory start-up services for the following items of equipment:

   a. Air handlers, fans, and heating equipment
   b. Chemical water treatment
   c. Control systems

2. Normal start-up services required to bring each system into a fully operational state. Provide skilled technicians to start up and debug all systems within Division 23. This includes motor rotational check, belt and alignment checks, cleaning, filling, purging, leak testing, testing control sequences of operation, full-load and part-load performance, etc. The demonstration and training is not to be performed until each system is complete, including normal start-up and testing.

D. Prepare, complete and sign start-up and test forms for each piece of equipment and system. Contractor is responsible for assuring the items checked off as complete are ready for demonstration.

3.2 DEMONSTRATIONS

A. The same technicians that performed start-up and testing shall demonstrate the systems. Work schedules, time required for testing, etc., will be coordinated by the Contractor and submitted to

the Owner. Contractor will ensure that the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary demonstrations.

B. The Owner or his representative reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or subsystem. Qualifications of technicians will include expert knowledge relative to the specific equipment involved. Contractor shall also provide adequate documentation and tools as necessary to start up and test the equipment, system, and/or subsystem.

3.3 WORK TO RESOLVE DEFICIENCIES

A. In some systems misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to start-up, test, and commission the systems. This work will be completed under the direction of the Owner's representative. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Owner will have final jurisdiction over any additional work done to achieve performance.

B. Division 23 corrective work must be completed in a timely fashion to permit the timely completion of the start-up, testing, and commissioning process. Experimentation to demonstrate system performance may be permitted.

3.4 ADDITIONAL COMMISSIONING

A. Additional start-up, testing, and commissioning activities may be required after system adjustments, replacements, etc., are completed. The Contractor shall complete this work as part of the Contractor's basic contractual obligations.

3.5 SEASONAL COMMISSIONING

A. Seasonal commissioning pertains to testing under full-load conditions during peak heating and cooling seasons, as well as part-load conditions in the spring and fall. Initial commissioning will be done as soon as contract work is completed, regardless of season. Subsequent commissioning shall be undertaken at appropriate times thereafter to ascertain adequate performance during the different seasons.

B. Cooling equipment will be tested as close to summer design extremes as possible (subject to Owner's schedule limitations) with a fully occupied building. Contractor shall perform the initial and the alternate peak season tests of the systems as required to demonstrate performance.

C. Training will be conducted by the Contractor and vendors. The Contractor will be responsible for highlighting system peculiarities specific to this project. .

END OF SECTION 23 08 01

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SECTION 23 0913 – INSTRUMENTATION AND 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 Specifications, apply to this Section.

B. Related Sections:

1. Division 01, Section "General Commissioning Requirements" for responsibilities and procedures of the Commissioning Agent.
2. Division 23, equipment and system sections with specific control requirements.
3. Division 26, sections for electrical equipment and wiring and conduit requirements and any electrical interface to the controls and instrumentation.

C. Products Supplied, But Not Installed Under This Section:

1. Controls Contractor shall provide all automatic temperature control dampers which are not part of packaged equipment, for installation by the Mechanical Contractor under the Control Contractor's supervision.
2. The Controls Contractor shall make all necessary connections (pneumatic and electrical) to the control system.

1.2 SYSTEM DESCRIPTION

A. Design Requirements:

1. Coordination: This Contractor shall interface with controls furnished with equipment. Provide additional control devices, interlock relays, and signal conditioners and gateways/routers when necessary to accomplish specified sequences and interoperability.
2. Electrical wiring in connection with the automatic temperature control system, where shown on the Division 26 drawings, shall be performed by the Electrical Contractor. All other wiring required for proper operation of the automatic temperature system shall be performed by this Contractor.
3. Adjustments of manual balancing devices, as required to obtain design air and/or water flows shall be by the Balancing Contractor. Controls Contractor shall provide assistance to Balancing Contractor with control adjustments as required to obtain design flows by:

    a. Providing on-site instruction on the proper interfacing and operation of their equipment.
    b. Providing the necessary software for use with Balancing Contractor's personal computer for interfacing with their control equipment. Where proprietary software, equipment or gateways are required, this equipment shall be provided for Balancing Contractor's use.

4. Commissioning of building systems shall be by the Commissioning Agent. This Contractor shall be responsible for startup, checkout, and debugging of all equipment installed and/or modified under this section. The Controls Contractor shall fully participate in the commissioning process and assist the Commissioning Agent with control demonstration and software adjustments, required for proper operation. This Contractor shall cooperate with the Commissioning Agent as to startup procedures, scheduling, performance verification, and system debugging. The Controls Contractor shall:

    a. Provide on-site instruction on the proper interfacing and operation of their equipment and provide a printout of all software code and all user interface screens.
    b. Provide the necessary software for use with the Commissioner's personal computer for interfacing with the control equipment. Where proprietary software, equipment or gateways are required, it shall be provided for the Commissioning Agent's use.
    c. Provide any portable hand held setup/calibration devices required to initialize the control system for the Commissioning Agent's use.
    d. Provide personnel to demonstrate the operation of the hardware and software during the commissioning process.

B. DDC Requirements: DDC Controllers shall utilize peer-to-peer communications. Each DDC controller shall operate independently by performing its own specified control, alarm management, operator I/O, and data collection. The failure of any single component or network connection shall not disrupt the execution of control sequences at other operational devices.

1.3 SUBSTITUTION APPROVALS

A. Where no specific manufacturer is listed, a first-class item of cataloged manufacture shall be furnished.

B. Prior Approvals: Refer to Division 01 Section "Product Substitution Procedures."

C. Substitution Requests after Execution of Contract: If Contractor wishes to furnish or use a substitute item of material and/or equipment; he must submit a change order request to the Architect/Engineer. The request for change order shall itemize each of the proposed substitutions identified by applicable specification section, paragraph number and/or drawing number. A price change (increase or decrease) shall be listed for each item along with complete data showing performance over entire range, physical dimensions, electrical characteristics, material construction, operating weight and other applicable data. The change order request will be reviewed for equality, suitability and reasonableness of price differential. A single substitution change order listing the approved items will be issued with the net cost of the change order being the sum of the approved item costs. No subsequent substitution change orders will be considered. The Engineer's decision will be final.

D. It shall be the responsibility of the Contractor to assure that the substitute material and/or equipment fits into the space provided and the Contractor shall pay for all extra costs incurred by other trades for any and all changes necessitated by these substitutions.

1.4 SUBMITTALS

A. Schedule: Submittal data and control drawings for all equipment and systems shall be submitted to the Architect/Engineer for review prior to ordering or fabrication of the equipment. The following information shall be included in these submittals:

1. 30 Days or Less After Notice to Proceed:

a. Damper schedules.
b. The damper schedules shall also be submitted to the mechanical contractor for review by the piping and sheet metal contractors.
c. Product data including all products used in conjunction with the control system.

2. 60 Days or Less After Notice to Proceed:

a. Control drawings
b. Software information
c. Test Plan and procedures

B. Shop Drawings:

1. General:

a. Drawings shall be prepared using computer aided drafting which can produce files compatible with AutoCAD 2007 or later.
b. Product data shall be in a 3-ring binder. All product information shall be indexed and tabbed. The product data sheets shall be marked with the tag number as indicated by the drawings. All options, ranges, and voltages that are to be provided shall be clearly indicated on each product data sheet.

2. Damper Schedules:

a. Damper schedules may be included on the drawings or in the product data. The damper schedule shall include the following information:

1) Damper tag number
2) System and service
3) Quantity
4) Size
5) Manufacturer and model number
6) Fail position
7) Type (opposed, parallel)
8) Actual pressure drop
9) Quantity of actuators
10) Actuator model number
11) Actuator spring range

3. Drawings: The drawing package shall include:

a. Cover sheet with a drawing index listing all included drawings.

b. Control schematics and flow diagrams for each system monitored or controlled. These diagrams shall include:

1) A ladder diagram showing all wiring and pneumatic tubing associated with the controller. The location of the electrical power panel with breaker number shall be shown for all power sources.
2) Details showing the interconnection with motor starters, variable frequency drives and the associated bypass sections, chillers, boilers and other types of equipment. These details shall include wire numbers terminal designations and protocol and physical media (wire type). The mounting locations of all control equipment shall be included.
3) A bill of materials shall be included with each control schematic. The bill of materials shall include the tag name used on the control drawing, description of the product, name of the manufacturer, complete model number, measurement range (if applicable) and quantity.
4) A complete input/output schedule for each DDC controller shall be included with each control schematic. The point name (the same one used in the software), and a functional description of the point shall be included in the I/O summary.
5) A sequence of operation shall be included with each control schematic. The sequence shall reflect actual programming, including all time delays and software interlocks. Copies of the sequence that appear in this specification are not acceptable.
6) Floor and roof plans showing the location of control panels, sensor, network devices, and mechanical equipment. The floor plans shall show the location of duct and space static pressure sample points.

C. Software: Software submittal shall include the following:

1. Point listings shall include all hardware and software points. Object lists for network interoperation with other equipment including VFDs and chillers. A description of the point shall be provided.
2. Program listings for each piece of controlled equipment. The program listing shall be complete with all data required for controller operation.
3. Color printout of each graphic. The graphic shall show temperature, status, position and all data points that will appear on the screen. Optionally, the graphics may be submitted on CD or disk provided that all required software for the display of the graphics is also furnished.
4. A listing of all alarms and the alarm limits and time delays.

D. Seismic Control Data: Submit all required information by the Delegated Design Professional in responsible charge of design for Seismic Controls for this project. Where specification Section 23 0548 “Wind, Seismic, and Vibration Controls for Mechanical Systems” does not indicate any required seismic controls, no such submittal is required.

E. Wind Resistance Data: For all systems and equipment installed outdoors, submit shop drawings indicating the design of the supports and curbs, the attachments to supports and curbs, and the attachment of the support and curbs to the structure, slab, or grade as required to provide resistance to the wind forces identified in specification section 23 05 48 “Wind, Seismic, and Vibration Controls for Mechanical Systems.” Where there is no product of this section installed outdoors, no such submittal is required.

F. Quality Assurance/Control Submittals:

1. Test Plan and Procedures: The test plan shall include the following:

   a. Certification documentation for each hardware point. Certify that the point was verified, tested and cycled to prove functionality. Include the calibration data, initial and final readings and the required offset.
   b. Test data form for testing pneumatic tubing.
   c. Procedures for the 7-day test.
   d. Certification documentation for software sequence of operation.

G. Close-out Submittals - Project Record Documents:

1. Upon completion of the installation, provide a complete set of record (as-built) drawings. The content and format of the drawings shall be as described previously.
2. Prior to final completion of the installation, prepare complete Operation and Maintenance (O&M) manuals. Refer to Division 01, Section “Submittal Procedures” for requirements. Also provide one CD ROM containing all CAD-prepared drawing files compatible with AutoCAD 2007 or later.
3. The temperature control diagrams shall be laminated and secured to the panel.
4. Control System Programmer's manual with complete description of the custom control language and associated editor, including sample-written programs. Provide complete sets of all programming forms, applications memorandums, and addenda to the programmer's manual. All software and firmware algorithms shall be completely described and documented.
5. Maintenance, installation, and engineering manual(s) that clearly explain how to debug hardware problems; how to repair or replace hardware; preventative maintenance guidelines and schedules; calibration procedures; and how to engineer and install new points, panels, and operator interfaces.
6. Documentation of all software: List separately all software parameters that may need updating by the Owner, such as, though not limited to, daily start/stop schedules; set points; alarm points; control loop cascade, and PID parameters, etc.
7. All programs, code, databases, graphic files, CAD drawings, and symbol libraries generated for operation of the system shall be included as part of the system documentation. This information shall be submitted both in hard copy bound format on CD-ROM.
8. Complete original issue documentation, installation, operation manuals, and supporting software for all third-party hardware and software furnished and installed as part of the system or required for the operation of the system, including remote terminals, user's computer workstation, monitors, graphics and memory boards, network servers, printers, and modems.
9. All software licenses, warranty certificates and documentation for all hardware and software including third-party hardware and software shall be provided.
10. All testing, startup, calibration, and check-out reports and checklists.
11. A list of recommended spare parts with part numbers and supplier.
12. Recommended preventive maintenance procedures for all system components including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Approved Controls Manufacturers and Installing Contractors:

Controls Manufacturers	**Installing Contractors**
Johnson Controls Inc.	Local Field Office

2. Manufacturers not listed in item 1 above may request approval by submitting a proposal at least 15 days prior to bid date. The proposal shall include the information listed below.

   a. A listing of all personnel that will be assigned to this project, their position, and a resume of experience.
   b. An analysis of compliance to this specification. Indicate for each paragraph compliance or exception. If the product or service does not completely match the requirements, indicate exception and describe fully the area(s) of deviation and their impact on system functionality. This analysis shall be presented in the opposing page format. The specification shall be presented on one page with the compliance or exception described on the opposing page.
   c. A sample of the as-built documentation for a project of similar magnitude. This sample shall include items specified in this specification insofar as possible.
   d. A list of references with project descriptions for five local installations of similar scope and magnitude. Include contact names and phone numbers for an operating engineer, facility manager and the consulting engineer for each reference.

B. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing. This requirement is not intended to restrict the Contractor to the use of outdated equipment.

C. All products used in this installation shall be new and currently under manufacture. Spare parts shall be available for at least five years after completion of this contract.

D. All work, materials and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes:

1. International Building Code (IBC)
2. International Mechanical Code (IMC)
3. American Society of Mechanical Engineers Controls and Safety Devices for Automatically Fired Boilers)
4. International Fire Code (IFC)
5. National Electric Code (NEC)
6. Occupational Safety and Health Act (OSHA)
7. Applicable state and local codes

1.6 WARRANTY

A. Refer to the General Conditions of the Contract and Division 01 for general warranty requirements and duration.

B. Special Warranty:

1. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.

   a. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
   b. Warranty for normal non-emergency service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request. The response time to critical problems shall be 4 hours maximum.
   c. Warranty Period: 1 year(s) from date of Substantial Completion.

2. The warranty period shall begin as authorized by the Owner's representative in writing. Completion shall not occur before the Contractor has performed the tests required in Article 3.
3. Contractor shall receive calls during the warranty period for all problems or questions experienced in the operation of the installed equipment and shall take steps to correct any deficiencies that may exist.
4. Contractor shall maintain a backup of all software installed in the system. A backup shall be made whenever the contractor makes a change to the software.
5. Contractor shall furnish and install all hardware, firmware, and software updates to operator workstations and controllers or webserver software, project-specific software, graphic software, database software, and firmware that resolve identified software deficiencies at no charge during warranty period. Do not install updates or upgrades without Owner's written authorization. If available, Owner can purchase an in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items.

1.7 OWNERSHIP OF PROPRIETARY MATERIAL

A. All project-developed software and documentation shall become the property of the Owner. The Owner shall retain the right to duplicate and/or modify such for use at this facility. These documents shall not be copyrighted. These include but are not limited to:

1. Project graphic images
2. Record drawings
3. Project database
4. Job-specific application programming code
5. All project specific documentation

1.8 START-UP AND TROUBLESHOOTING

A. This Contractor is responsible for the calibration, start-up, and trouble shooting of the control system. This includes programming modifications to the control sequences to account for

unanticipated operating issues, seasonal recommisioning, and any system performance issues that are identified during the warranty period. This contractor shall provide detailed 48-hour trend data (graphs) at the request of the engineer to assist in problem identification.

1. The intent of this specification is to provide the Owner with a fully operational system. Sequence of operation changes may be required during startup and warranty period as noted above. Contractor shall provide support, modify and adjust sequences and devices as required to provide a system which maintains space conditions with optimum efficiency. Tuning is an iterative process, control loops shall be tuned for proper response in all operating conditions and seasons.
2. Contractor shall make the required modifications at no additional cost.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Object Command: The maximum time between the command of a binary object by the operator and the reaction by the device shall be less than two seconds. Analog objects should start to adjust within 2 seconds.

2.2 CONTROL WIRING

A. Cables shall be shielded when so recommended by manufacturer. Conductor size shall be in accordance with manufacturer's recommendations subject to specified minimum size. See Part 3 for allowable types.

B. All low-voltage cables in plenums, not in raceway, shall be UL listed for air plenum service.

C. All insulated wire to be copper conductors, UL labeled for 90°C minimum service.

D. Raceway for wiring shall be per Division 26.

2.3 TRANSIENT VOLTAGE PROTECTION

A. TVSS surge protectors, for incoming 120V AC power to controllers: Leviton 51020WM, or Engineer-approved equal. Surge protectors furnished shall be UL 1449 listed. The maximum single-pulse transient current shall be 26kA, noise rejection at 50 ohms -40 to -50 for 5K to 100mhz, the cat B3 combination wave peak clamping voltage shall be L-N 300 V, L-G 350 V, the UL 1499 ratings shall be L-N330V, L-G 400V, Fault current rating (AIC rating assigned per UL) shall be 5000A.

1. Transient voltage protection for all twisted pair, telephone and coaxial data communication lines between controllers shall be per manufacturer recommendations. Provide all required repeaters to ensure signal integrity.
2. Lightning arrestors on all communications and other lines that exit the building shall be per manufacturer recommendations.

2.4 CONTROL DAMPERS

A. Motorized control dampers, unless otherwise specified elsewhere, shall be as follows:

1. Control dampers shall be parallel or opposed blade type as below or as scheduled on drawings.

   a. Outdoor and/or return air mixing dampers and face and bypass (F&BP) dampers shall be parallel blade.
   b. Other modulating dampers shall be opposed blade type.
   c. Two-position shutoff dampers may be parallel or opposed blade.

2. Damper frames shall be built to the structural equivalent of 13-gauge steel channel and shall be galvanized or extruded aluminum with reinforced corner bracing or welded corners.
3. Damper blades shall not exceed 8 inches (203mm) in width or 48 inches (1.2m) in length. Blades are to be suitable for medium velocity performance (2000 fpm) (10.2m/s). Blades shall be not less than 16 gauge.
4. Damper shaft bearings shall be oil impregnated bronze or stainless steel. Thrust bearings, and other special construction as required, shall be provided when dampers are to be used in blade-vertical position.
5. All blade edges and top and bottom of the frame shall be provided with replaceable butyl rubber, neoprene, or PVC-coated polyester fabric seals. Side seals shall be spring loaded stainless steel.
6. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 10.7 cfm per sq. ft. (33 L/s per sq. m) at a static-pressure differential of 4.0 inches water column (1000 Pa) when a torque of 5 inch pounds per sq. ft. (30.1 Newton meters per sq. m) is applied to the damper jackshaft.
7. Individual damper sections shall not be larger than 48" x 60" (1.2m x 1.5m). Provide a minimum of one damper actuator per section.
8. Ruskin CD60 airfoil, CD-36 Triple V or Engineer-approved equal.

2.5 LOCAL CONTROL PANELS

A. All indoor control cabinets shall be fully enclosed NEMA 1 construction with hinged door, key-lock latch, baked enamel finish, removable subpanels, wall-mounted or freestanding. All temperature control panels on the project shall be keyed alike.

B. Panels shall house the microprocessor, modem, communication interface, all controllers, relays, indicators, transmitters, switches, pilot lights, override timers, etc., to allow quick access for adjustment and troubleshooting.

C. Manual switches and indicating devices shall be flush-mounted on panel face. Provide engraved plastic or lithographed metal nameplates for all items on the panel face.

D. Interconnections between internal and face-mounted devices prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminal blocks shall be provided for all field connections, and shall be UL listed for 300-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring.

1. Control terminations for field connection shall be individually identified per control drawings.
2. All internal wiring between panel mounted devices and field terminal blocks shall be marked on both ends with the appropriate identifying tag.

E. Provide on/off power switch with over-current protection to each local panel. Provide a 120 volt duplex outlet inside each control panel that houses a DDC controller if there is not an outlet within 5 feet (1.5m) of the enclosure.

2.6 TEMPERATURE SENSORS

A. Temperature sensors shall be thermistor (10K or 20K), or platinum RTD type (100-ohm wire wound, or 1000-ohm, thin film. Accuracy shall be ±0.5°F (0.3°C) with stability of 0.25°F (0.14°C) over five years. Sensors used for BTU calculations shall be accurate to ±0.2°F (1.0°C) or 1% of span, whichever is less.

1. Space (room) sensors shall be surface-mounted in a suitable protective enclosure. Space sensors serving VAV boxes or duct heating coils shall have a set point adjustment. Additionally, VAV terminal sensors shall have a network connection jack. Covers shall be blank, without any company logos. Omit thermometers and digital displays. Provide insulating mounting base on all sensors located on exterior walls. Provide metal guards with security screws for all sensors located in public areas such as lobbies, corridors, gyms, cafeterias, etc.

B. Duct and immersion sensors shall be immune to moisture and shall have a junction box for electrical connections. Sensing element shall be suitable for the application.

1. Provide averaging elements for mixed air applications.
2. Provide separable wells and insulation extension for immersion applications.
3. Provide sun shields for outdoor sensors.

C. Thermowells for all immersion sensors shall be stainless steel as recommended by manufacturer for the application. They shall have 1/2-inch (DN15) or 3/4-inch (DN20) external NPT threads and shall provide for extension to sensor electrical junction box on insulated pipes.

2.7 TRANSMITTERS - SOLID-STATE

A. Space or duct humidity transmitters shall be "Vaisala" capacitive type using thin film technology. Units shall have 2% accuracy from 0-90% RH at 68°F (20°C) and 4-20 mA output.

1. "HMD/W 60U" or Engineer-approved equal. Combination temperature and humidity sensors are not acceptable.

B. Outdoor humidity transmitters shall be "Vaisala" capacitive type using thin film technology. Units shall have 2% accuracy from 0-90% RH at 68°F (20°C) and 4-20 mA output.

1. "HMD60UO" or Engineer-approved equal. Provide with "Vaisala" solar radiation/ precipitation shield "2212HM" and mounting bracket. Combination temperature and humidity sensors are not acceptable

C. Water pressure transmitters shall have stainless steel diaphragm construction, proof pressure of 150 psi (1.0MPa) minimum, and the accuracy shall be ±0.2% of calibrated span. Transmitter shall be complete with 4-20 mA output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.

1. Foxboro IGP-10 series, , or Engineer-approved equal.

D. Water differential pressure transmitters shall have stainless steel diaphragm construction, proof pressure of 150 psi (1.0MPa) minimum, and the accuracy shall be ±0.25% of calibrated span. Overrange limit (ΔP) and maximum static pressure shall be 3000 psi (21MPa). Transmitter shall be complete with 4-20 mA output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service. All water service differential pressure transmitters shall have a differential pressure gauge mounted at the transmitter.

1. Foxboro IDP-10 Series
2. Differential pressure gauges for water service shall be Dwyer Capsuhelic or Engineer-approved equal.

E. Differential pressure transmitters for space and duct static pressure shall have the following performance characteristics:

1. Accuracy:

   a. Terminal Point (including Hysteresis) ±1.0% Full Scale
   b. Best Fit straight Line ±0.6% Full Scale

2. Stability (F.S./Year): ±1.0%
3. Temperature Limits:

   a. Storage: –40 to 180°F (-40 to 82°C)
   b. Operating: 0 to 160°F (-18 to 71°C)
   c. Humidity: 10 to 95% R.H. non-condensing)

4. Overpressure Limits: Proof: 5 psid(34.5KPa), Burst: 25 psi (172KPa)
5. 5. Mounting Position Error: 0.5 inch w.c. (124Pa) span and higher: ≤0.1% f.s. Below 0.5 inch w.c. (124PA): ≤0.25% f.s.
6. 6. Compensated Range: 40 to 125°F(4 to 52°C), thermal coefficients zero and span: ±0.025%F.S./°F (±0.025%F.S./°C)
7. 4-20 mA output, non-interactive and externally accessible zero and span adjustments
8. Response Time: 250 m sec
9. Transmitters shall have direct-acting, linear output signal compatible with controller. Zero and span shall be field-adjustable.

10. Transmitter range (span) shall be suitable for application, typically as follows:

    a. Static Pressures:

        1) Building S.P. -0.1 inch to +0.1 inch w.g.(-25Pa to 25Pa)
        2) Supply duct S.P. 0 inch to 3 inch w.g. or 1.0 inch to 4 inch w.g.(0Pa to 750Pa or 25Pa to 100Pa)

11. Ashcroft RXLdp, Air Monitor, or Engineer-approved equal
12. Provide wind dampening "weatherhead" for outdoor atmospheric pressure sensing. Dwyer A-306 or Engineer-approved equal.
13. Indoor space static pressure sensor locations shall use a blank thermostat cover with mounting frame or Engineer-approved equal.
14. Duct static pressure sensing shall utilize Static pressure sensing tips, Dwyer A-301or A-302 or Engineer-approved equal.
15. All air service differential pressure transmitters shall have a differential pressure gauge mounted on the control panel door. Differential pressure gauges for air service shall be Dwyer, Magnehelic 2000 series, or Engineer-approved equal.

F. Differential pressure transmitters for differential pressures less than 3 inch w.g. used with airflow measuring stations

1. The transmitter shall be capable of receiving flow signals (total and static pressure) from an airflow station or probe array and produce an output linear and scaled for air volume, velocity, differential pressure, etc. The transmitter shall output a 0-5VDC, 0-10VDC, or 4-20mADC control signal.
2. The transmitter shall contain an integral multi-line digital display for use during the configuration and calibration process, and to display one transmitter output. All transmitter configuration, parameter setting, zero and span calibration, plus display formatting and scaling will be performed digitally in the on-board microprocessor via input pushbuttons.
3. The transmitter shall be available in multiple natural spans covering the range of 0.05 inch w.c. (12Pa) to 25.0 inch w.c. (6.2KPa) with an accuracy of 0.25% of natural span. The transmitter shall not be affected by over pressurization up to 25 psig (172.3KPa). The auto-zeroing calibration shall be accomplished by switching the process input variable to 0 inch w.g. psid(0Pa). The indicating transmitter shall be housed in a NEMA 1 enclosure with integral terminal box, with power and output signal conduit connection ports and separate access plate.
4. The transmitter shall be capable of having its operating span electronically selected without having to perform recalibration involving an external pressure source.
5. The transmitter-controller shall be the VELTRON DPT 2500-Plus as manufactured by Air Monitor Corporation, Santa Rosa, California; or Engineer-approved equal.

G. Carbon Dioxide Sensor: Unit shall have a non-dispersive infrared (NDIR) detection cell, 0-2000 ppm measurement range, adjustable span, automatic electronic zero, ±75 ppm annual drift, ±20 ppm repeatability and 5% accuracy. Unit shall require calibration not more than annually and shall have 4-20 mA or 0-10 VDC analog output and duct sampling tubes for duct-mounted applications. Provide calibration kit containing one lecture bottle of 100% nitrogen and one lecture bottle containing Nitrogen and CO2 at 2000 ppm.

1. ACI CO2-VDC-Rr, Veris Industries CWE SC, Telaire Ventostat 8001 or 8002. Other makes/models will not be accepted.

2.8 AUXILIARY DEVICES - ELECTRIC

A. Water Flow Switches: Flow switches shall be electronic type with no moving parts, 316L stainless steel sensor, sensor operating range -50°F to 350°F, sensor operating pressure 4000 psig, 24V dc/V ac power, relay output SPDT 3-amp resistive, suitable for mounting in 3/4-inch weld-o-let, insertion length and extended sensor head as recommended by the manufacturer for pipe size and insulation thickness. Ameritrol FX-0750 series.

B. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application, or as specified.

1. Fan Operation: Dwyer Model 1823 or Engineer-approved equal.
2. Chillers and Heat Exchanger: United Electric J21K series or Engineer-approved equal.

C. Current-operated switches shall be self-powered, solid state split core with manually adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system. The current switch shall have sufficient accuracy and hysteresis to detect drive belt failure. Where used in conjunction with variable frequency drives the current operated switch shall be recommended for such service by the manufacturer. Neilsen-Kuljian, Veris Industries, or Engineer-approved equal.

D. Damper end switches shall be UL listed, line voltage SPDT snap-acting, pilot duty rated (125 VA minimum) NEMA 1 enclosure, with roller type actuating arm suitable for damper position application. Switches containing mercury are not acceptable.

E. Control relays shall be UL listed plug-in type with dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage suitable for application. Idec series RH-L, ULAC or Engineer-approved equal.

F. Control transformers shall be UL listed, Class 2 current-limiting type or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.

G. Manual control switches shall be UL listed for use in NEMA 1 enclosures with contact arrangement and rating suitable for application. Bat handle or knob actuator with nameplate clearly identifying function of each switch position.

H. Air Filter Alarm Switch:

1. Switches shall be diaphragm operated with 4-inch (102mm) diaphragm to operate a single pole double throw snap switch.
2. Unit shall be rated for 45-inch w.g. (11.2KPa) maximum pressure, have adjustable set point and shall have an operating range suitable for the type of service. The repetitive accuracy shall be within 2%.
3. The unit shall have aluminum die cast housing with steel cover. Dwyer series 1800 or Engineer-approved equal.

2.9 ACTUATORS AND POSITIONERS - ELECTRIC

A. Externally Mounted Damper Actuators:

1. The actuator shall be direct-coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assembly shall be of a "V" bolt design.
2. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.
3. For power-failure/safety applications, a spring return mechanism shall be built into the actuator. All spring return actuators shall be capable of both clockwise and counterclockwise spring return operation by simply changing the mounting orientation.
4. Proportional actuators shall have a control input signal compatible with the control system. All actuators shall provide a 2 to 10 dc position feedback signal.
5. All 24V ac/V dc actuators shall not require more than 10V A for AC or more than 8 watts for DC applications. Actuators operating on 120V ac power shall not require more than 10V A.
6. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb torque capacity shall have a manual crank for this purpose.
7. Actuator size and rating shall be suitable for intended application.
8. Damper actuators shall be selected per manufacturer's recommendations to provide sufficient close-off force to effectively seal damper.
9. Furnish a separate actuator for each damper section.
10. Actuators shall be UL 873or UL60730-1A/-2-14 listed.
11. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a 2-year manufacturer's warranty. Manufacturer shall be IS09001 certified. Actuators shall be as manufactured by Belimo or Engineer-approved equal.

B. Internally Mounted Damper Actuators:

1. Electric actuators shall be either, direct coupled or rotary (gear-train) type for two-position or modulating service as required by application. All electric actuators shall be UL listed with NEMA 1 enclosures, unless otherwise specified.
2. Actuators shall be permanently lubricated; gear-train units shall be oil-immersed type or shall have permanently lubricated high-density polymer gears.
3. Ambient temperature range shall be at least 40° to 120°F (4 to 49°C), except actuators subjected to outdoor ambients shall have ambient range of -20° to 125°F (-29 to 52°C) minimum.
4. Input signal requirements and voltages compatible with controller output signals.
5. Actuator size and rating shall be suitable for intended application.
6. Damper actuators shall be selected per manufacturer's recommendations to provide sufficient close-off force to effectively seal damper. Modulating actuators shall provide smooth modulating control under design flow and pressure conditions. Furnish a separate actuator for each damper section.
7. Actuators shall have a spring return to fail to the safe position as indicated on the drawings. Actuators relying on batteries are not acceptable.

2.10 BUILDING CONTROLLERS

A. DDC controllers shall function as totally stand-alone units to monitor and control individual systems in accordance with the specified sequence of operation, incorporating field devices to perform operational status and alarm functions.

B. Each DDC controller shall contain all necessary hardware and software functions as required to interface installed sensors and control devices with the building network, and shall contain sufficient memory to support the operating system, Database, data logging, and programming requirements at its maximum point configuration. The Building controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours. Imminent failure of backup batteries (if used) shall be reported as a service alarm.

C. Input/Output Capability:

1. All input and output points shall be protected such that shorting the point to it, another point, or to ground will cause no damage to the controller. All I/O points shall be protected from the direct application of 24V, such that no damage to the controller shall occur.
2. Analog Input (A/I) Function: Monitor each analog input, perform A/D conversion and hold the digital value in a buffer for interrogation. A/I's shall be sampled twice per second or better. Minimum resolution of A/I conversion shall be twelve bits. All analog inputs shall have programmed high- and low-alarm values, unless otherwise specified. A short or open on the input wiring shall cause an alarm and the controller shall use the last valid value for control. Status (value) shall update at intervals not exceeding one second.
3. Digital Input (D/I) Function: Accept dry contact closures and voltage level transitions. Withstand continuous direct shorting to 24V ac, 60 Hz power without failure. Status (value) shall update at intervals not exceeding one second.
4. Pulse Accumulator Function: Same characteristics as the D/I, except that in addition a buffer shall be required to totalize pulses between interrogations. The pulse accumulator shall accept rates up to 10 pulses/second.
5. Analog Output (A/O) Functions: Accept digital data and perform D/A conversions. Minimum resolution of A/O conversion shall be 8 bits. Output signal shall be compatible with system actuators, or shall be industry standard voltage or current type with I/P transducers.
6. Digital Output (D/O) Function: Provide contact closures for momentary and maintained operation of field devices. Closures shall have a minimum duration of one second. Provide isolation and protection against voltage surges up to 300V ac peak. Minimum DO contact rating shall be two amps at 24 to 240V ac, pilot duty; supplementary control relays shall be furnished when necessary.
7. Provide individual manual override switches for each digital and analog output. Provide means to manually adjust signal level of analog outputs in override mode. Each switch shall be individually supervised to indicate the switch is not in the automatic position.

D. Local DDC controllers shall be selected to provide a minimum of 15% unused I/O point capacity at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required.

E. The local DDC controllers shall have an on-board keypad interface with a minimum 28-alphanumeric character display, or shall be capable of communication through a plug-in portable

service tool or CRT/keyboard terminal. If on-board interface is not included, one such portable terminal shall be provided as part of the base contract. Use of the portable tool shall not interrupt communications from the controller to the high- or low-level networks.

F. Each primary controller shall include a real-time clock, two-way communication ports for transfer of data to and from the Local (building) Area Network, and shall also include at least two industry standard ports for use by a portable laptop terminal, phone modem, and/or a service tool.

G. Controllers shall be fully supervised to detect both internal and I/O failures. Upon failure, the stand-alone panel shall automatically force outputs to a pre-determined state. A message shall be transmitted to the central interface unit indicating local failure.

H. Controllers shall be protected from unauthorized access. If not provided with limited access as standard, install in an auxiliary enclosure with key lock.

I. Immunity to power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 watts at 3 feet (.9m).

J. Environment: Controller hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient shall be mounted in waterproof enclosures and shall be rated for operation at -40°F to 140°F (-40°C to 60°C).
2. Controllers used in conditioned ambient shall be mounted in dust-proof enclosures and shall be rated for operation at 32°F to 120°F (0°C to 50°C).

K. Serviceability: Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to be field removable, modular terminal strips or a termination card connected by a ribbon cable.

2.11 BUILDING CONTROLLER SOFTWARE

A. The custom application programming language shall be based on the syntax of BASIC or C. Program code shall be liberally commented so that a user unfamiliar with programming languages can understand the program. Alternatively, the programming language may be graphically based using function blocks as long as blocks are available that directly provide the functions listed below, and that custom function blocks can be created. Provide all of the software and/or CAE required to modify all controller's programs and databases. Provide complete software and programming manuals for each type of controller on the project.

B. All I/O point status readouts shall indicate the engineering units; i.e., on, off, open, closed, gpm, cfm, fpm, °F, psi, inches w.g., etc. The displayed value of commands to valves and dampers shall take into account the spring range of those devices and display the actual commanded position. 100% shall indicate the open position.

C. Software shall provide Run-Time Totalization as follows:

1. Provide monitoring and totalization of the run times for all digital outputs that have a corresponding status input.

2. A high run time alarm shall be assigned. Unique, user-specified messages shall be generated when the limit is reached.
3. Run times can be reset by an operator having the necessary access level. The date on which the value was reset shall be logged.
4. Run times shall be totalized up to 9999 hours before resetting to 0. Automatic resetting to 0 shall generate a suitable message.
5. The totalization routine shall have a sampling resolution of one minute or less.

D. Alarm Functions:

1. Digital, analog and high/low settings and deadband.
2. Conditional alarms with If/Then/Else logic.
3. Alarm inhibiting (lockout of alarms when equipment is off).
4. Fluttering alarm suppression.
5. Customized alarm messages of at least 70 characters (at central workstation).
6. Where applicable assign each alarm point a return-to-normal deadband.
7. Any analog value which is the result of a mathematical calculation shall be assignable as an alarm.
8. An alarm point can be inhibited by another digital point if desired. The condition of the digital point when the inhibit condition occurs can be operator programmed for either an open contact or a closed contact.
9. Provide time delays for alarms that are easily changed by the user.
10. Alarms with appropriate analog limits and inhibit (alarm lockouts) shall be assigned to each analog point.
11. Warning and alarm set points shall track control set points whenever another condition or variable resets the control set points.
12. Alarms shall be assigned to each digital point. Provide command fail interlock for digital outputs.

E. Optimum Start Stop:

1. Optimum start/stop programs shall be applied to all equipment with occupancy schedules.
2. This package shall continuously monitor all of the space temperature sensors served by a respective air-handling unit and outside air temperature for each system specified to be under optimized start-stop control. The control algorithm shall start the system at the latest possible moment as necessary to warm the space up to the required temperature (or to cool the space down to the required temperature) prior to scheduled occupancy. When multiple space sensors are associated with a unit, the space temperature sensor that has the largest deviation from set point (heating or cooling) shall be used to determine the optimal start/stop times for that AHU.
3. The initial setup of this package shall be based on empirical, or theoretical, calculations based on the building's construction, orientation, and mass. The package shall be structured such that job site tuning may be done by simple keyboard entry of one multiplier to the empirical formula or it shall be adaptive.
4. Time of day, calendar based, and holiday scheduling (clock functions) functions shall be available in addition to the optimum start/stop.

F. DDC controllers shall count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly, or monthly basis.

1. The event totalization feature shall be able to store the records associated with a minimum of 9999.9 events before reset.
2. There shall be a user adjustable warning limit. Unique user-specified messages shall be generated when the limit is reached.

G. Diagnostics:

1. Capable of self-diagnosing without a query by an operator.
2. Alarm a power failure or a communication failure with any controller. Repeat alarms at programmable intervals while the situation remains unattended and unacknowledged. Acknowledging and silencing alarms shall be a simple procedure from a remote PC or the central interface controller.

H. All software, compilers, engineering tools and systems required for the user to modify or create new custom applications and modify the database for any programmable devices used on this project shall be provided.

2.12 TEMPERATURE SENSORS

A. Temperature sensors shall be thermistor (10K or 20K), or platinum RTD type (100-ohm wire wound, or 1000-ohm, thin film. Accuracy shall be ±0.5°F (0.3°C) with stability of 0.25°F (0.14°C) over five years. Sensors used for BTU calculations shall be accurate to ±0.2°F (1.0°C) or 1% of span, whichever is less.

1. Space (room) sensors shall be surface-mounted in a suitable protective enclosure. Space sensors serving VAV boxes or duct heating coils shall have a set point adjustment. Additionally, VAV terminal sensors shall have a network connection jack. Covers shall be blank, without any company logos. Omit thermometers and digital displays. Provide insulating mounting base on all sensors located on exterior walls. Provide metal guards with security screws for all sensors located in public areas such as lobbies, corridors, gyms, cafeterias, etc.

2.13 TRANSMITTERS - SOLID-STATE

A. Carbon Dioxide Sensor: Unit shall have a non-dispersive infrared (NDIR) detection cell, 0-2000 ppm measurement range, adjustable span, automatic electronic zero, ±75 ppm annual drift, ±20 ppm repeatability and 5% accuracy. Unit shall require calibration not more than annually and shall have 4-20 mA or 0-10 VDC analog output and duct sampling tubes for duct-mounted applications. Provide calibration kit containing one lecture bottle of 100% nitrogen and one lecture bottle containing Nitrogen and CO2 at 2000 ppm.

1. ACI CO2-VDC-Rr, Veris Industries CWE SC, Telaire Ventostat 8001 or 8002. Other makes/models will not be accepted.

2.14 CONTROL VALVES

A. Shall be 2-way or 3-way type for two-position or modulating service as scheduled, shown on drawings, or as specified in Sequence of Operation.

B. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum closeout pressure ratings:

1. Water Valves:

a. 2-way - 150% of total system (pump) head.
b. 3-way - 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

2. Steam Valves: 150% of operating (inlet) pressure.

C. Water Valves:

1. Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
2. Rangeability of control valves shall be as follows:

a. Valves NPS 1/2 (DN 15) through NPS 1 (DN255), 25:1 minimum
b. Valves NPS 1 (DN 25) through NPS 3 (DN 800), 50:1 minimum
c. Valves over NPS 4 (DN 10000), 50:1 minimum

3. Sizing and Selection Criteria:

a. Flow velocities shall not exceed the manufacturer’s recommendations.
b. Two-position service: Line size.
c. Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 4 psi (27.6KPa) maximum, 2 psi (13.8KPa) minimum.
d. 3-way Modulating Service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 3 psi (20.7KPa) maximum, 2 psi (13.8KPa) minimum.
e. 2-way modulating valves NPS 2 (DN 50) and smaller may be ball type valves with factory installed actuators (in lieu of globe type) for water service.
f. Modulating water valves NPS 4 (DN 100) and larger may be tight-closing butterfly type with electric or pneumatic actuators with positioners (in lieu of globe type). Maximum 60-degree rotation.

4. Materials:

a. Valves NPS 1/2 through NPS 2 (DN 15 through DN 50) shall be bronze body or cast brass ANSI Class 250, spring loaded, Teflon packing, quick opening for two-position service. Two-way valves to have replaceable composition disc.
b. NPS 2-1/2 (DN 65) valves and larger shall be cast iron ANSI Class 125 with guided plug, stainless steel stems, and Teflon packing.

5. Butterfly Valves: Full-lug type, 250 psi (1.7MPa) WOG, extended neck, cast iron body, aluminum bronze disk, stainless steel shaft, field replaceable cartridge design, EPDM seat

and seal with integral actuator. 3-way valves shall be factory linked. Provide with factory assembled actuators, travel limit stops, and position switches specified elsewhere. Actuators and all accessories shall be factory-mounted. Pentair Keystone Fig. 222 or Engineer-approved equal.

6. Ball Valves (water service only): Valve body shall be forged brass or bronze, two-piece construction with stainless steel ball and stem, reinforced Teflon seat and two O-ring packing, 600 psi (4.1MPa) (NPS 1/2 to NPS 1-1/4) (DN 15 to DN 32) 300 psi (2MPa), (NPS 1-1/2 to NPS 4) (DN 40 to DN 100) pressure rating at 254°F(123°C). The valve shall have a flow characterizing disk in the inlet of the valve to provide an equal percentage response. Provide with factory assembled actuators. The valve actuator assembly shall have a minimum 200 psi (1.4KPa) close off. Belimo or Engineer-approved equal.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Demolition: This Contractor shall remove all unused controls including devices, conduit, wire, and pneumatic tubing. Disposition of hardware shall be coordinated with the Owner. Selected material shall be returned to the Owner. Coordinate work with other trades.

3.2 CONTROL EXECUTION - GENERAL

A. This Contractor shall provide all required control interface relays, including control contactors for single-phase pumps and fans (1/2 hp (375W) or less) and any isolation relays required for interface to 3-phase magnetic starter control circuits. All power wiring to single-phase motors and 3-phase starters by Division 26; all control function (interlock) wiring by the Controls Contractor.

B. This Contractor shall be responsible for providing control power to all his controllers and devices requiring control power including installation of any required breakers, unless such wiring is shown on the Division 26 drawings.

C. This Contractor shall function as the Systems Integrator to establish interoperability with the controls system its LAN and controllers provided by other Sections including variable frequency drives (VFD), air handlers furnished with packaged controls, chillers and boilers, and other equipment designated to be connected on the LAN. This Contractor shall map all points indicated, connect wiring, provide any required converters, bridges or gateways and assure seamless bi-directional communication and interoperability and full functionality of the interface.

D. Hand-Off-Auto switches at the MCC shall energize equipment in both the 'hand' and 'auto' mode (when auto is commanded on for auto mode). Safeties shall protect equipment in the hand and auto modes. Where fans are interlocked with damper end switches, the hand and auto positions shall open the dampers and the damper end switch shall energize the fan.

3.3 CONTROL WIRING

A. All control and interlock wiring shall comply with the national and local electrical codes and Division 26 of these specifications. Where the requirements of this section differ with Division 26 the more restrictive requirements shall take precedence. Control wiring shall be concealed except in equipment rooms.

B. All Power (line voltage) and Class 1 wiring shall be UL listed in approved raceway per NEC and Division 26 requirements.

C. All Power limited circuits (Class 2 or Class 3) shall be UL listed in approved raceway per NEC and Division 26 requirements.

D. Size wire in accordance with manufacturers recommendations and the NEC.

E. All wiring shall be installed as continuous lengths with no splices permitted between termination points.

F. All control wiring shall be installed in a neat and workmanlike manner parallel to building lines with adequate support.

G. This Contractor shall terminate all control and/or interlock wiring and maintain updated (as-built) wiring diagrams with terminations identified at the job site.

H. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3 feet (.9m) in length and shall be supported at each end. Flexible metal conduit less than 1/2-inch (13mm) electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

I. Provide conduit seal-offs where portions of an interior raceway system pass through walls, ceiling or floors which separate adjacent rooms having substantially different maintained temperatures or when a raceway goes from indoors to outdoors.

J. Wiring for analog inputs shall not be run in conduit containing 120V ac wiring or any wiring that carries switched signals or any noise-generating sources. Pneumatic tubing shall not be in the same conduit with wiring.

K. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring. When plenum cable is not allowed, LAN or communication wire shall be installed in a dedicated raceway. Other wiring in communications raceway is not allowed.

3.4 TRANSIENT VOLTAGE PROTECTION

A. This Contractor shall provide and install:

1. Transient voltage protection, on all incoming 120V ac power to all controllers (except VAV controllers).

2. Transient voltage protection for all twisted pair, and coaxial data communication lines between controllers. Provide all required repeaters to ensure signal integrity.
3. Transient voltage protection on all phone lines.
4. Lightning arrestors on all communications and other wiring that exit the building. Locate the arrestor at the point of building entrance.
5. Provide ground connection sized and installed in accordance with the manufacturers instructions.

3.5 CONTROL PANELS

A. Field wiring to panels shall be enclosed in metal raceway.

B. Panels shall be mounted at eye level for accessibility and service.

C. Local control panels shall be located within 50 feet of the system served unless otherwise shown on plans.

D. Mount panels on solid non-vibrating surfaces in areas free from moisture or water accumulation. Where such surfaces are not readily accessible, mount the panel on a rigid unistrut stand attached to the floor. The sides of ducts and air handling units are not acceptable mounting surfaces.

3.6 FIELD DEVICE INSTALLATION

A. Actuators: Mount and link control damper actuators per manufacturer's instructions.

1. To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately a 5-degree open position, manually close the damper, and then tighten the linkage.
2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

3.7 IDENTIFICATION

A. All control equipment shall be clearly identified by control shop drawing designation as follows:

1. Control valves - brass tags.
2. Other remote control devices and sensors: metal tags; plastic laminate labels; or, on non-porous surfaces only, permanent label tape as produced by the Brother “Easy Touch” label maker. Do not attach tag or label to removable covers, etc. Rivet or stick to device or adjacent surface.
3. Control panel doors - engraved nameplate with panel number and systems served.
4. Devices in control panels: engraved plastic tags; metal tags; or, on non-porous surfaces only, permanent label tape as above, mounted to panel adjacent to control device. 1/4-inch-high letters minimum
5. All wiring, including wiring within factory-fabricated panels, shall be labeled within 2 inches of termination with DDC point number/controller number or other descriptive information.

6. All metal and plastic engraved labels shall be secured with chains, nylon tie-wraps, or rivets. Screws with exposed threads are not acceptable. Permanent adhesive is acceptable only when mechanical fasteners would damage the labeled equipment.
7. All switches, relays, and panel components shall be labeled. Relays shall be labeled such that removal of the relay does not move the label.
8. Raceway identification: For ease of identification, junction and pull box covers shall be color coded. Coordinate the color of the junction box covers with Division 26 and the Owner.

3.8 TESTING

A. Prior to substantial completion, the control system shall undergo a series of tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed their own performance tests.

B. The tests described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, startup, and debugging process. Control system testing shall be coordinated with the Commissioning Contractor and scheduled with the Owner's representative.

C. Contractor shall provide at least two men equipped with two-way communication, and shall test actual field operation of each control and sensing point for all modes of operation including day, night, summer, winter, occupied, unoccupied, fire/smoke alarm, and power failure modes. The purpose is to test the calibration, response, and action of every point. Any test equipment required to prove the proper operation shall be provided by and operated by the Contractor. The Commissioning Agent and the Owner's Representative (at their discretion) may observe and review these tests.

1. The system software shall be complete such that each control loop shall function as specified in the Sequence of Operation. This contractor shall be required to furnish the software program and test the operation of every program branch and control loop.
2. This Contractor shall be responsible for all necessary revisions to the software as required to provide a complete and workable system consistent with the letter and intent of the specification.

D. A point-to-point verification shall be made for each input and each output to the system. The check shall include the operator workstation such that the correct point assignment at the workstation is also verified. The calibration of all input and output points shall be tested, documented and calibrated as needed.

3.9 SYSTEMS INTEGRATION

A. Variable Frequency Drive Control Network Requirements: The VFD shall communicate the following data over the network. Coordinate with the VFD supplier to assure compatibility of the network protocol and physical media. This contractor shall act as a Systems Integrator to assure that the systems are compatible and communicating effectively and at an acceptable speed.

Object Type	Sequential Number	Generic Data Name	VFD Data Name (varies by manufacturer)
BI	1	Drive Run Status	Run/Stop ACT
BI	2	Drive Fault Status	Fault ACT
BI	3	Alarm ACT	Alarm ACT
BI	4	Drive at set point	At Set point
BO	5	Start/Stop	Run/Stop CMD
AO	6	Speed	Analog input 1
AI	7	Run time	Run Time (R)
AI	8	Current	Current
AI	9	Power	Power (kW)
AI	10	KWH Counter	KWH

END OF SECTION 23 0913

SECTION 23 1123 – FUEL GAS PIPING 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 Specifications, apply to this Section.

1.2 SUBMITTALS

A. Product Data: Submit product data for the following items:

1. Valves, manual and automatic
2. Pressure-reducing stations
3. Gas meters

B. Seismic Control Data: Submit all required information by the Delegated Design Professional in responsible charge of design for Seismic Controls for this project. Where Section 23 0548, "Wind, Seismic, and Vibration Controls for Mechanical Systems" does not indicate any required seismic controls, no such submittal is required.

C. Wind Resistance Data: For all systems and equipment installed outdoors, submit shop drawings indicating the design of the supports and curbs, the attachments to supports and curbs, and the attachment of the support and curbs to the structure, slab, or grade as required to provide resistance to the wind forces identified in specification section 23 05 48 "Wind, Seismic, and Vibration Controls for Mechanical Systems". Where there is no product of this section installed outdoors, no such submittal is required.

D. Close-out Submittals: Submit operating and maintenance instructions on the following items.

1. Valves, manual and automatic
2. Pressure-reducing stations
3. Gas meters

1.3 QUALITY ASSURANCE

A. Certifications: All fittings, valves, PRVs, etc., shall be UL recognized or AGA/API certified for fuel gas service.

1.4 SEQUENCING/SCHEDULING

A. Coordinate all work with all other trades and utility companies for elimination of interference; utilization of combined hanger support systems; timely routing and installation of systems; verifications of existing utilities, locations, depths, and connection regulations; and proper

valving and junction structures or fittings. Location and furnishing of pressure-reducing stations and/or meters as applicable and appropriate.

1.5 GAS SERVICE

A. Existing gas service is to be utilized to serve the new equipment. No work shall impact the high pressure gas yard. The low pressure gas yard shall remain in place with the new gas piping re-routed as shown on the drawings. Coordinate outages with University, the outage must occur between May and September. .

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Interior Exposed and Concealed, with Operating Pressures from 15-inch w.c. to 25 psig:

1. Size NPS 3/4 (DN 18) through NPS 2 (DN 50):

a. Pipe: Schedule 40, ASTM A 53, Grade B black steel, Type E or ASTM A 106, Grade B carbon steel, Type S.
b. Wrought Steel Fittings: ASTM A 234, seamless or welded; ASME B 16.9, butt welding type; and ASME B16.11, socket-welding type.
c. Unions: ASME B16.39, Class 150, malleable-iron, with brass to iron seat, ground joint.

2. Size NPS 2-1/2 and Over:

a. Pipe: Schedule 40, ASTM A 53, Grade B black steel, Type E or ASTM A 106, Grade B carbon steel, Type S.
b. Wrought Steel Fittings: ASTM A 234, seamless or welded; ASME B 16.9, butt welding type.
c. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1) Material Group: 1.1.
2) End Connections: Threaded or butt welding to match pipe.
3) Lapped Face: Not permitted underground.
4) Gasket Materials: Asbestos free, ASME B16.20 metallic, or ASME B16.21 nonmetallic, gaskets compatible with fuel gas.
5) Bolts and Nuts: ASME B18.2.1, cadmium-plated steel.

B. Exterior Aboveground with Operating Pressures to 25 psig:

1. Size NPS 1/2 (DN 13) through NPS 2 (DN 50):

a. Pipe: Schedule 40, ASTM A 53, Grade B black steel, Type E or ASTM A 106, Grade B carbon steel, Type S.

b. Malleable Iron Fittings: ASME B16.3, Classes 150, standard pattern.
c. Unions: ASME B16.39, Class 150, malleable-iron, with brass to iron seat, ground joint.
d. Joint Seal: Teflon.

2. Size NPS 2-1/2 and Over:

a. Pipe: Schedule 40, ASTM A 53, Grade B black steel, Type E or ASTM A 106, Grade B carbon steel, Type S.
b. Wrought Steel Fittings: ASTM A 234, seamless or welded; ASME B 16.9, butt welding type.

c. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1) Material Group: 1.1.
2) End Connections: Threaded or butt welding to match pipe.
3) Lapped Face: Not permitted underground.
4) Gasket Materials: Asbestos free, ASME B16.20 metallic, or ASME B16.21 nonmetallic, gaskets compatible with fuel gas.
5) Bolts and Nuts: ASME B18.2.1, cadmium-plated steel.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches.
9. NSF Certified for kitchen appliances

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

2.3 GAS VALVES

A. Manual Shutoff Valves:

1. Steel Pipe: Two –piece ball type forged brass body, 175 psig WOG, UL, AGA, or API recognized for fuel gas service. Threaded ends for NPS 3 or smaller. Apollo 80-100-1 or Nibco 585.
2. Lubricated Plug Flanged ends for NPS 4 and larger. SMG Key Port Fig. 425, Mueller "Luboseal" gas meter valve, Rockwell lubricated plug cocks, Resun Fig. D-125 through NPS 4, Fig. D-126 for NPS 5 and larger, Walworth Series 1700 (screwed) and 1700 F (flanged).
3. PE Pipe: Plug type through NPS 1-1/4, ball type for NPS 2 to NPS 4, ASTM D-2513, 80 psig minimum allowable pressure rating. Material and SDR to be same as PE pipe material. Rockwell "Polyvalve" or approved equal.

B. Electric Emergency Shutoff Solenoid Valve:

1. Shutoff Valve: Bronze or aluminum body solenoid valve with Buna "N" seat, 120 VAC, 60 Hz, Class F continuous duty molded coil. The valve shall be normally closed, UL listed for 0 to 5 psi natural gas safety shutoff, automatic reset. Threaded end for NPS 2 and smaller, and flanged end for NPS 2-1/2 and larger. ASCO Model 8215 or approved equal, size as indicated on the drawings.
2. Valve Control Station:

   a. Provide an 8" x 8" x 4" deep NEMA 1, UL-listed gas valve control panel with brushed stainless steel cover for flush mounting. The control station shall provide a red pushbutton switch for emergency valve shutoff, a key-operated spring-return switch for manual reset, a latching type 120V ac control relay, and a red "on" pilot light. ASCO 108D90C, ISIMET, or approved equal.
   b. The gas valve control station permits energization of a normally closed solenoid valve by operation of the front cover-mounted key switch. If control voltage is lost, the solenoid valve is de-energized and locked out. De-energization of the solenoid valve may also be accomplished by depressing the "off" pushbutton on the front cover. Reactivation of the solenoid valve can only be accomplished via the key switch. The red lamp shall indicate when the solenoid valve is energized.

3. Valve Ceiling Enclosure: Provide a 2' x 2' x 1'-deep solenoid valve enclosure box with a perforated face and a hinged cover suitable for installation in a T-bar grid ceiling (see plans for detail and locations).

C. Earthquake Valves: Comply with ASCE 25.

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. Pacific Seismic Products, Inc.

2. Listing: Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction.

3. Maximum Operating Pressure:

   a. 0.5 psig (3.45 kPa) - NPS 3/4 (DN 20) to NPS 1-1/2 (DN 40)
   b. 7 psig (48 kPa) - NPS 1-1/4 (DN 32) to NPS 1-1/2 (DN 40)
   c. 60 psig (414 kPa) - NPS 3/4 (DN 20) to NPS 62 (DN 150)

4. Cast-aluminum body with stainless steel internal parts.
5. Nitrile-rubber, reset-stem o-ring seal.
6. Valve position, open or closed, indicator.
7. Composition valve seat with clapper held by spring or magnet locking mechanism.
8. Level indicator.
9. End Connections: Threaded for valves NPS 2 and smaller; flanged for valves NPS 2-1/2 and larger.

2.4 UNDERGROUND VALVE BOXES

A. Provide each valve on buried piping with a cast-iron valve box of a size suitable for the valve. The valve box shall have a round cover with the word "Gas" cast on it. The valve boxes shall be provided with lock-type covers that require a special wrench for removing. Each cast-iron box shall be given a heavy coat of bituminous paint.

2.5 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mil thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Provide all fuel gas piping from source to each connection point of all gas-fired equipment items. Provide a drip leg, gas shutoff valve, and union for each equipment item. Make final connections in compliance with equipment manufacturer's instructions. Flexible connections will not be allowed, except where explicitly specified or shown.

B. Piping:

   1. General:

      a. Install fuel gas distribution piping in accordance with jurisdiction codes, local utility company requirements, and NFPA 54.
      b. Install a "Tee" fitting with a drip leg at the bottom of pipe risers or drops, fitted with full size 6-inch-long nipples capped at the bottom.

c. Use dielectric unions where dissimilar metals are joined together.
d. Use Teflon joint seal on metal gas piping threads.
e. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping or equipment connections are completed.
f. Install gas shutoff valve and strainer ahead of gas pressure regulators.
g. Gas pressure regulators shall be accessible and vented to the outside of the building.
h. Paint exterior pipe per Section 23 0500.
i. Refer to Division 23 Section 23 0529, "Hangers & Supports for Mechanical Systems," for additional installation requirements. Refer to Division 23 Section 23 0548 "Wind, Seismic, and Vibration Controls for Mechanical Systems" for seismic and wind restraints.

2. Special requirements for installation of PE gas piping (exterior underground):

a. Install underground, PE, natural-gas piping according to ASTM D 2774 with the applicable requirements of ANSI B31.8. Install a detectable warning tape with buried PE pipe to facilitate location with an electronic detector. Install wire 8 inches to 12 inches above pipeline and terminate 3 inches to 4 inches above grade. Do not wrap wire around pipe.
b. Terminate PE pipe above grade with abodeless risers. Protect risers and connections from damage.
c. Install an underground manual PE shutoff valve with the valve box where shown.

3. Concealed Locations:

a. Above Ceilings: Gas piping may be installed in accessible above-ceiling spaces (subject to the approval of the authority having jurisdiction), whether or not such spaces are used as a plenum. Valves shall not be located in such spaces, and all gas piping shall be welded.
b. Concealed and Inaccessible: When gas piping is installed under concrete slabs or in non-ventilated concealed areas (chases, crawl spaces, non-ventilated and inaccessible ceiling spaces, etc.), install gas piping in an air-tight conduit constructed of Schedule 40 steel pipe with welded joints. Conduit shall be vented to the outside at both ends and shall terminate with screened rainproof vent caps. Conduit shall be sealed to the gas pipe whenever it terminates (leaves a non-ventilated space).

4. Prohibited Locations:

a. Do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumb waiter, or elevator shaft. (This does not apply to accessible above-ceiling space specified above.)
b. Gas piping shall not be installed in or on the ground under any building or structure, and exposed gas piping shall be kept at least 6 inches above grade or structure. The term “building or structure” shall include structures such as porches and steps (whether covered or uncovered), breezeways, roofed porte-cocheres, roofed patios, carports, covered walks, covered driveways, and similar structures or appurtenances.

5. Protective Coating: When metallic piping and fittings will be in contact with material or atmosphere exerting a corrosive action or installed below grade, all pipe and fittings shall be factory or field wrapped with polyethylene tape having the following properties:

    a. Overall thickness: 20 mil (50% overlap)
    b. Synthetic adhesive
    c. Water vapor transmission rate: 0.10 gallon per 100 square inches, or less
    d. Water Absorption: 0.02% or less
    e. All fittings shall be double-wrapped 40 mil

C. Gas Valves:

1. Provide at supply runout connection for each gas-fired equipment item, at building entry, and on risers and branches where indicated.
2. Locate gas valves where easily accessible and where they will be protected from possible damage. Install per manufacturer's recommendations.
3. Do not install gas valves in plenums or concealed locations. Use a valve ceiling enclosure when shutoff valves are to be located in accessible ceilings.

D. Unions, Flanges, and Strainers:

1. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
2. Install flanges on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
3. Install strainers on the supply side of each control valve, pressure-reducing valve, pressure regulating valve, solenoid valve, and elsewhere as indicated.

E. Electrical Bonding and Grounding:

1. Install aboveground portions of gas piping systems, upstream from equipment shutoff valves electrically continuous and bonded to a grounding electrode in accordance with NFPA 70 of the National Electrical Code.
2. Do not use gas piping as a grounding electrode for other systems.
3. Conform to NFPA 70 - "National Electrical Code" for wiring and electrical connections to electrically operated control devices.

F. Equipment Gas Pressure Regulators:

1. Install regulators per manufacturer's recommendations and comply with utility requirements. Pipe atmospheric vents full size to outdoors. Install gas shutoff valve upstream of each pressure-regulating valve.

    a. Install NPS 3/8 plugged gauge tap both upstream and downstream (10 pipe diameters straight pipe where possible) of each regulator.

2. Do not install regulators in plenums or concealed locations.

3.2 FIELD QUALITY CONTROL

A. Testing:

1. All piping specified in this section shall be tested.

    a. All joints, fittings, and piping accessory items shall be exposed to view during tests whether pipe is above or below ground. "Closed-in" or "buried" piping shall be re-exposed during testing.
    b. Proper restraining of piping and test plugs shall be accomplished prior to test.
    c. Test connections can be anywhere in the system. Use certified 6-inch gauge with 1 psi division.
    d. In the event that tests fail, use a standard soap and brush inspection using "Trouble Bubble" liquid high density soap as manufactured by Jersey Meter Co., Patterson N.J. Formula ST-1. After source of failure is discovered, correct and retest system. Repeat procedure until system successfully sustains required testing.

2. Testing shall be of the complete piping system, before covering, or of individually separable larger portions of the system. Only the last connection to the appliance may be tested under operating conditions. This connection will be tested with soap and brush under line pressures. This connection must remain exposed.
3. Test Procedures: As required by Administrative Authority and NFPA 54.

    a. 15-inch w.c.to 5 psig Systems: 60 psig air pressure for a period of 2 hours with no drop in gauge pressure.
    b. 14-inch w.c. or Less: 10 psig air pressure for a period of 1 hour with no drop in gauge pressure.
    c. For PE piping, 5 psig air pressure for a period of 1 hour with no drop in gauge pressure.

4. Retesting: Retest any piping failing initial tests following correction of defective work. Requirements of initial tests shall apply.
5. Verification of tests shall be made by the plumbing inspector, or Owner's Representative.
    a. Testing contractor shall arrange a time and date with the plumbing inspector, or Owner's Representative so arrangements can be made for witnessing tests.
    b. Record pressure and ambient temperature at start and end of test. Submit written results of tests to the Owner's Representative.

END OF SECTION 23 11 23

SECTION 23 2113 – 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 Specifications, apply to this Section.

B. There is no high temperature hot water (HTHW) piping in this phase of the project. Refer to specifications for other phases of this project for requirements for HTHW piping the piping specified in this section is NOT suitable for HTHW.

1.2 SUBMITTALS

A. Product Data: Submit product data on piping materials, methods, and specialties.

B. Seismic Control Data: Submit all required information by the Delegated Design Professional in responsible charge of design for Seismic Controls for this project. Where Section 23 0548, "Wind, Seismic, and Vibration Controls for Mechanical Systems" does not indicate any required seismic controls, no such submittal is required.

1.3 QUALITY ASSURANCE

A. Certifications: All safety valves and pressure vessels shall bear the appropriate ASME label and stamp.

PART 2 - PRODUCTS

2.1 PIPING

A. Specification A:

1. Pipe: ASTM B88, Type L drawn temper seamless copper tube.
2. Fittings: ASME B16.22 wrought copper, ASME B16.18 cast copper alloy, or wrought-copper Viega ProPress fittings with EPDM-rubber O-ring seal in each end.
3. Flanges: ASME B16.24, Class 150 cast bronze flanges with solder joint ends
4. Unions: ASME B16.18, cast-copper alloy, hexagonal stock body with ball-and-socket joint, metal-to-metal seating surfaces, and solder joint and/or threaded ends
5. Solder Filler: ASTM B 32, Alloy Sn95, Sn94 or E; lead- free
6. Brazing Filler Metal: AWS A5.8 BcuP, copper phosphorus or BAg, silver classification

B. Specification B:

1. Pipe: ASTM B88, Type M drawn temper seamless copper tube
2. Fittings: ASME B16.22 wrought copper, ASME B16.18 cast copper alloy, or wrought-copper Viega ProPress fittings with EPDM-rubber O-ring seal in each end.
3. Flanges: ASME B16.24, Class 150 cast bronze flanges with solder joint ends
4. Unions: ASME B16.18, cast-copper alloy, hexagonal stock body with ball-and-socket joint, metal-to-metal seating surfaces, and solder joint and/or threaded ends
5. Solder Filler: ASTM B 32, Alloy Sn95, Sn94 or E; lead-free
6. Brazing Filler Metal: AWS A5.8 BcuP, copper phosphorus or BAg, silver classification

C. Specification C:

1. Pipe: ASTM A53, ERW, Grade B carbon steel pipe

   a. NPS 1/2 and Smaller: Schedule 80
   b. NPS 3/4 to NPS 10: Schedule 40
   c. NPS 12 and Larger: Standard weight

2. Fittings:

   a. NPS 2 and Smaller: ASME B16.4, Class 125 cast-iron threaded fittings, ASME B16.3, Class 150 malleable-iron threaded fittings
   b. NPS 2-1/2 and Larger: ASTM A234, Grade Grade WPB, butt weld standard weight wrought carbon steel

3. Unions: ASME B16.39, Class 150 malleable-iron union
4. Flanges: ASME B16.5, Class 150, ASTM 181 Grade. II, carbon steel, raised face

D. Specification D:

1. Pipe: ASTM A53, seamless, Grade B carbon steel pipe

   a. NPS 1/2 and Smaller: Schedule 80
   b. NPS 3/4 to NPS 10: Schedule 40
   c. NPS 12 and Larger: Standard weight

2. Fittings:

   a. NPS 2 and Smaller: ASME B16.4, Class 250 cast-iron threaded fittings, ASME B16.3, Class 300 malleable-iron threaded fittings
   b. NPS 2-1/2 and Larger: ASTM A234, Grade WPB, butt weld standard weight wrought carbon steel

3. Unions: ASME B16.39, Class 300 malleable-iron union
4. Flanges: ASME B16.5, Class 300, ASTM 181 Grade. II, carbon steel, raised face

E. Specification E:

1. Pipe: ASTM A53, seamless, Grade B carbon steel pipe

   a. NPS 10 and Smaller: Schedule 80
   b. NPS 12 and Larger: Extra strong

2. Fittings:

   a. NPS 2 and Smaller: ASME B16.4, Class 250 cast-iron threaded fittings, ASME B16.3, Class 300 malleable-iron threaded fittings
   b. NPS 2-1/2 and Larger: ASTM A234, Grade WPB, butt-weld standard weight wrought carbon steel

3. Unions: ASME B16.39, Class 300 malleable-iron union
4. Flanges: ASME B16.5, Class 300, ASTM 181 Gr. II, carbon steel, raised face

PART 3 - EXECUTION

3.1 PREPARATION SURVEYS

A. Surveys – Measurements, Lines, and Levels:

1. Check dimensions at the building site and establish lines and levels for the work specified in this section.
2. Establish all inverts, slopes, and elevations by instrument, working from an established datum point. Provide elevation markers and lines for the Owner's use to determine that slopes and elevations are in accordance with drawings and specifications.

B. Pipe Cleaning:

1. Clean interior of all piping before installation. Remove any fugitive dust, dirt, and/or threading debris.
2. Flush sediment out of all completed piping systems. Refer to Division 23 Section "Common Work Results for Mechanical Systems," for cleaning and flushing requirements.

3.2 PIPING APPLICATIONS

A. Chilled Water:

1. NPS 2 (DN 50) and Smaller: Pipe specification A or C
2. NPS 2-1/2 (DN 65) and Larger: Pipe specification C

B. Coil Condensate, Blowdown (*except steam*), Drain, and Vent:

1. NPS 2 (DN 50) and Smaller: Pipe specification A
2. NPS 2-1/2 (DN 65) and Larger: Pipe specification C

3.3 INSTALLATION

A. Piping Installation - General:

1. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, other design considerations. So far as practical, install piping as indicated. Ductwork shall take precedence over piping when coordinating work with other trades.
2. Provide a complete piping installation, including connections to equipment and installation of automatic control valves furnished by the Temperature Control Contractor. Install control valves with a minimum length equivalent to four pipe diameters of straight pipe entering valve and with the stem upright.
3. Support piping at connections to pumps so there is no strain on pump flanges.
4. Pitch piping to obtain required air relief and drainage.
5. Make an allowance for expansion in the installation of piping so the variation in temperature will not cause undue stress at any point. Securely anchor pipes where necessary to properly distribute expansion stresses. Support branch mains and risers in a way that will permit expansion and contraction of risers and to relieve runouts of all weight.
6. Provide unions or flanges at each control valve and at each piece of equipment.
7. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below Grade or floors, unless indicated to be exposed to view.
8. Refer to Division 23 Section 23 05 29 "Hangers and Supports for Mechanical Systems," for additional installation requirements. Refer to Division 23 Section 23 05 48 "Wind, Seismic, and Vibration Controls for HVAC for Mechanical Systems" for seismic restraints.

B. Condensate Drain Piping:
1. Provide condensate drain piping where required by mechanical equipment (air handling units, unit ventilators, etc.).
2. Pitch drain at 1% toward discharge location.
3. Daylight condensate drain to nearest floor drain or service sink, or as shown on plans.

3.4 FIELD QUALITY CONTROL

A. Pipe Testing:

1. All piping systems shall be tested and proven tight prior to insulation or concealment. The tests shall be witnessed by the Owner's Representative or his designee.
2. 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
3. Ensure that the test pressure, which might damage equipment, does not reach such units by valving them off or otherwise isolating them during the test.
4. Open and close all system valves at least once while system is pressurized to test valve packing. Tighten as required.
5. All hydrostatic tests shall be held for a minimum of four hours without loss of system pressure.

6. Test pressures shall be as follows:

    a. Hot Water/Chilled Water: 100 psig hydrostatic or 1.5 times operating pressure, whichever is greater
    b. Tower/Condenser Water Piping: 50 psig hydrostatic or 1.5 times operating pressure, whichever is greater
    c. Low-pressure Steam and Condensate Piping: 100 psig hydrostatic or 1.5 times operating pressure, whichever is greater
    d. Condensate Drain and Blow-Down Drain Piping: plug outlet, fill pipe with water to inlet, and visually inspect for leaks
    e. Chemical Treatment and/or Tower Bypass Filter Piping: 100 psig hydrostatic or 1.5 times operating pressure, whichever is greater
    f. Makeup Water Piping: 125 psig hydrostatic

END OF SECTION 23 21 13

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SECTION 23 3100 – DUCTS 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 Specifications, apply to this Section.

1.2 SUBMITTALS

A. Product Data for all items in this section.

1. Performance data including leakage, pressure drop, chemical resistance, and temperature range as appropriate.
2. Duct Liner may be submitted under this section or under Section 23 0700 Mechanical Insulation.
3. Include acoustical data for flexible duct, attenuators, and double wall duct

B. Shop Drawings: Shop Fabrication Standards listing system type, pressure class, seal class, material, sheet metal gage, reinforcement, seam and joint construction, and type and spacing of hangers and supports including methods for duct and building attachment for all duct systems of this project.

C. Delegated-Design Submittal: Custom Supports: Details, signed and sealed by the qualified professional engineer responsible for their preparation for hangers and supports not addressed in SMACNA standards or cataloged, pre-engineered product data.

D. Welding certificates.

E. Seismic Control Data: Submit all required information by the Delegated Design Professional in responsible charge of design for Seismic Controls for this project. Where Section 23 05 48 “Wind, Seismic, and Vibration Controls for Mechanical Systems” does not indicate any required seismic controls, no such submittal is required.

F. Operation and Maintenance Manuals: For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

G. Close-out Submittals: Operating test of Fire, smoke, and combination fire/smoke dampers.

1.3 QUALITY ASSURANCE

A. Comply with AMCA 500-D testing for damper rating.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1.

C. SMACNA Compliance: Applicable requirements of the current edition of:

1. HVAC Duct Construction Standards - Metal and Flexible
2. Rectangular Industrial Duct Construction Standards
3. Round Industrial Duct Construction Standards
4. System Air Leakage Test Standard

1.4 PERFORMANCE REQUIREMENTS

A. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

B. Contractor shall furnish and install ductwork and accessories, including offsets and size transitions, which may become evident during the course of construction, to avoid building construction and other considerations, to provide a complete and operational system. Make any adjustments in dimensions required to maintain the interior free area shown on the drawings where such adjustments are made or where duct is lined.

C. 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 specified design criteria.

D. Airstream Surfaces: Surfaces in contact with the air stream shall comply with requirements in ASHRAE 62.1.

PART 2 - PRODUCTS

2.1 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 (Z275).
2. Finishes for Surfaces Exposed to View or Weather: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008, with oiled, matte finish for exposed ducts.

D. 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.

E. Tie Rods: Same materials as duct, size per the appropriate SMACNA standard.

F. Intermediate Reinforcement: Match duct material.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Rectangular Ducts: Fabricate ducts with indicated dimensions for the duct airway size. Allowance for liner thickness must be added to airway size to determine sheet metal size.

B. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Rectangular Duct Construction" based on indicated static-pressure class unless otherwise indicated.

1. 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."

   a. Where specified for specific applications, all joints shall be welded.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal 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." Button punch lock, detail L-2, is not acceptable.

   a. Where specified for specific applications, all joints shall be welded.

3. 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."
4. Reinforcement Comply with SMACNA "HVAC Duct Construction Standards - Metal and Flexible," based on indicated static-pressure class unless otherwise indicated.

   a. Internal reinforcement is prohibited in duct with design velocity over 2250 fpm, or on any grease exhaust duct, or any material handling duct.

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. Round Ducts: Fabricate ducts with indicated dimensions for the inner duct airway size. Allowance for liner thickness must be added to airway size to determine sheet metal size.

B. 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.

1. 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."

   a. Transverse joints in ducts larger than 60 inches (1500-mm) in diameter shall be flanged.
   b. Where specified for specific applications, all joints shall be welded.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round 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." Snap lock seams, RL-6A, RL-6B, RL-7, and RL-8 and lap rivets, RL-3 and RL-4 are not acceptable.

   a. Fabricate round ducts larger than 90 inches (2250-mm) in diameter with butt-welded longitudinal seams.
   b. Where specified for specific applications, all joints shall be welded.

3. Laterals and Tees Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals" and SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," 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."

   a. Saddle Taps are not allowed, except where specifically shown on drawings as connections to existing duct.

2.4 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 723certified by a nationally recognized testing laboratory.

B. 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-inch (50-mm).
2. Manufacturer: Carlisle Hardcast DT-5300-Tape with RTA-50 coating or approved equal.
3. Sealant: Modified styrene acrylic.
4. Water resistant.

5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10” w.g. (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to 200°F (-40 to +93°C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Manufacturer: Carlisle Hardcast DS-321 coating or approved equal.
2. Application Method: Brush on.
3. Solids Content: Minimum 65%.
4. Shore A Hardness: Minimum 20.
5. Water resistant.
6. Mold and mildew resistant.
7. VOC: Maximum 75 g/L (less water).
8. Maximum Static-Pressure Class: 10” w.g. (2500 Pa), positive and negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
11. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
12. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. Description: Extruded butyl/EPDM proprietary copolymer sealant on a siliconized release paper.
2. Manufacturer: Carlisle Hardcast GT-1902, or approved equal.
3. Dimensions: 3/16 inch x 5/8 inch (5-mm x 16-mm)
4. Resistant to mold, mildew, and water:
5. Service temperature: Minus 65 to plus 200°F (minus 54 to plus 93°C).
6. VOC: 0 g/l.
7. Maximum Static-Pressure Class: 10” w.g. (2500 Pa), positive and negative.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals: Seal shall provide maximum leakage class of 3 cfm/100 sq ft at 1” w.g. (0.14 L/s per sq m at 250 Pa) and shall be rated for 10” w.g. (2500-Pa) static-pressure class, positive or negative.

1. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
2. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 FABRICATED 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. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. 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.

2.6 STEEL CABLE SYSTEMS FOR DUCT SUPPORT

A. Manufacturer: Gripple.

B. Manufactured and engineered specifically for duct supports.

C. Cables for Galvanized Duct: Galvanized steel complying with ASTM A 603.

D. Cables for Stainless steel Ducts: Stainless steel complying with ASTM A 492.

E. 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.

F. Contractor shall select, apply, and install hanging and support components in complete compliance with manufacturer’s requirements and recommendations.

2.7 DUCT TAKE OFF WITH MANUAL VOLUME DAMPERS

A. Conical Spin In Fitting With Damper

1. Type: Single blade up to 20-inch (500-mm) diameter.
2. Maximum Velocity: (2,000 fpm) (10 m/s) or less.
3. Sleeve: 20-gauge (1.3-mm) galvanized steel or stainless steel.
4. Blades: 20-gauge (1.3-mm) galvanized steel or stainless steel.
5. Shafts: 0.375-inch (9.5-mm) square.
6. Bearings: Synthetic, on each side of damper shaft.
7. Insulation Stand Off To Accommodate Insulation Thickness.
8. Locking quadrant with locking wing nut on each side of damper shaft.

B. Damper Actuators: Provide locking quadrant operators on all dampers unless otherwise noted on plans

2.8 MANUAL VOLUME DAMPERS

A. Manufacturers:

1. Air Balance
2. American Warming and Ventilating
3. Arrow
4. Greenheck
5. Louvers & Dampers
6. Nailor
7. Pottorff
8. Ruskin
9. Vent Products
10. Venco

B. Rectangular, Steel, Low Velocity

1. Manufacturer: Ruskin MD35, Greenheck MBD-15 or equal
2. Type: Parallel blade or opposed blade with concealed or exposed linkage, all galvanized steel or all stainless steel
3. Maximum Velocity: (1,500 fpm) (7.5 m/s) or less
4. Frame: 16-gauge (1.3-mm), roll formed channel
5. Blades: 16-gauge (1.3-mm)
6. Maximum Blade Width: 8 inches (200-mm), exception: single blade up to 12 inches (300-mm)
7. Blades 36 inches (900-mm) and longer and driven blade shall be furnished with reinforcing cone. Maximum blade length is 48 inches (1,200-mm)
8. Shafts: 1/2-inch (13-mm)
9. Bearings: Synthetic
10. Insulation Stand Off To Accommodate Insulation Thickness.

C. Round, Steel

1. Manufacturer: Ruskin MDRS25, Greenheck MBDR-50 or equal.
2. Type: Single blade up to 20-inch (500-mm) diameter; use rectangular steel with round adapter above 20-inch (500-mm) diameter.
3. Maximum Velocity: (2,000 fpm) (10 m/s) or less.
4. Frame: 20-gauge (1.3-mm) galvanized steel or stainless steel.
5. Blades: 20-gauge (1.3-mm) galvanized steel or stainless steel.
6. Shafts: 0.375-inch (9.5-mm) square.
7. Bearings: Synthetic.
8. Insulation Stand Off To Accommodate Insulation Thickness.

D. Damper Actuators: Provide locking quadrant operators on all dampers unless otherwise noted on plans

2.9 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Flexmaster U.S.A., Inc.
5. Greenheck Fan Corporation
6. McGill AirFlow LLC
7. Nailor Industries Inc.
8. Pottorff; a division of PCI Industries, Inc.
9. Ventfabrics, Inc.
10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors. Fabricate and install access panels according to the duct pressure classifications requirement’s for each system, and to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1. Low pressure duct-mounted access doors, for rectangular ducts, with a pressure classification below 3”wc:

a. Doors shall have minimal to no leakage while tested below 3”wc:
b. Door: Double wall galvanized steel panels.
c. Frame: Galvanized steel, dovetail, spin, or press on frames is acceptable.
d. Insulation: High density insulation fill, with UL classification FHC25/50.
e. Vision panel at humidifiers or as otherwise noted.
f. Hinge: Full length galvanized steel piano hinge secured to both frame and door.
g. Cam and Latches: The cam shall be manufactured from no less than 16 gauge galvanized steel, secured to the door. The latches shall be manufactured from no less than 20 gauge galvanized steel, secured to the frame.
h. Gasket: Service temperature range of -20 ° F to 150 ° F.

2. Low pressure duct-mounted access doors, for round ducts, with a pressure classification below 3”wc.

    a. Minimal to no leakage while tested bellow 3”wc:
    b. Door: Galvanized steel panels.
    c. Insulation: High density insulation fill, with UL classification FHC25/50.
    d. Vision panel at humidifiers or as otherwise noted.
    e. Hinged Type: Full length galvanized steel piano hinge, with no less than 2 latches secured to both panel, and duct on all hinged doors.
    f. Sandwich Type: Door consists of multiple layers of stamped steel. With molded knobs that have threaded metal inserts to eliminate thread stripping, carriage bolts are secured to inner door with springs to allow for the panel to be easily removed.
    g. Gasket: Service temperature range of -20 ° F to 150 ° F.

2.10 FLEXIBLE CONNECTORS

A. Manufacturers

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4”-wide x 0.028”-thick (70-mm x 0.7-mm), galvanized sheet steel or 0.032-inch-thick (0.8-mm) aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200°F (Minus 40 to plus 93°C).

2.11 FLEXIBLE DUCTS

A. Manufacturers:

1. Flexmaster Type M1
2. ThermaFlex M-KE
3. Alternate Manufactures - Submit sample for review.

B. Flexible Ducts:

1. Flexible air ducts shall be listed under UL-181 standards as Class I Air Duct. Material and shall comply with NFPA Standards 90A and 90B. Minimum operating pressure rating shall be 10" W.C. positive, 1” negative for sizes up to 12” through a temperature range of -20°F to 150°F; minimum working velocity rating shall be 4000 fpm.
2. Inner core shall be black CPE supported by a galvanized steel helix, with minimum R-5 insulation and metalized reinforced outer jacket. Non-insulated flexible ducts shall be the same as insulated less the insulation and other jacket.
3. All flexible duct shall be rated for sound attenuation. Sound attenuation shall be as scheduled below:

INSERTION LOSS dB (6-foot Section, less than 2,500 FPM Air Velocity						
Octave Band	125	250	500	1000	2000	4000
8" Diameter	5	16	17	18	16	11
12" Diameter	8	17	14	18	14	11

4. Flexible Duct Connectors: Clamps: Stainless steel band with cadmium-plated hex screw to tighten band with a worm-gear action.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Duct Installation:

1. 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 ductwork systems including field identified offsets and adjustments required to avoid conflict with building construction and other conditions. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings, Coordination Drawings, or Requests for Information.
2. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
3. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
4. 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.
5. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
6. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
7. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
8. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

9. 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.
10. Where ducts pass through fire-rated interior partitions and exterior walls in unsprinkled buildings, install fire dampers.
11. All ductwork shall be fabricated and installed so that no undue vibration or noise results. Joints per seal class shall be sealed airtight with additional taping and caulking provided if necessary.
12. Provide all necessary manual, backdraft, and relief dampers as required for proper adjustment and control of air distribution.

    a. 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.
    b. Install steel volume dampers in steel ducts.
    c. Install aluminum volume dampers in aluminum ducts.
    d. Set dampers to fully open position before testing, adjusting, and balancing.
    e. Install fire and smoke dampers according to listing and manufacturer's recommendations.
    f. Backdraft and relief dampers shall be installed per the manufacturer's recommendations.

13. At all places where inside of duct will be visible through grilles, louvers, etc., paint visible inside portion of duct flat black.
14. Install duct access doors in the most practical location to gain access to the interior of the duct to allow for inspecting, adjusting, and maintaining accessories and equipment. Duct access doors shall be no less than 1/3 of the duct width/height dimension and no smaller than 12" x 12". If ductwork dimension is smaller than 12" provide access door the same size as duct. Duct access doors are required at the following locations:

    a. Upstream of duct coils.
    b. Upstream from duct filters.
    c. At outdoor-air intakes and mixed-air plenums.
    d. At intake and exhaust louvers.
    e. At drain pans and seals.
    f. Upstream from backdraft dampers.
    g. Upstream from equipment.
    h. Upstream of control dampers.
    i. Upstream security bars.
    j. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Paint access doors red. Provide min 12" x 12" door.
    k. Upstream from turning vanes in ducts 3" pressure class and over
    l. Upstream from duct silencers.
    m. Control devices requiring inspection.
    n. Elsewhere as indicated.

15. Install flexible connectors to connect ducts to equipment.

16. For fans developing static pressures of 5” w.g. (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
17. 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 (6-mm) movement during start and stop of fans.
18. Transitions in ductwork, in changing shapes and sizes, shall be made with angles not exceeding 15 degrees (diverging) or 30 degrees (converging) wherever possible.
19. Flexible duct shall be used on supply diffuser run outs only, and only where indicated. Flexible ducts shall be installed using lengths not exceeding 5 feet to make the connection. Flexible duct shall be suspended at the manufacturer’s recommended intervals, but not exceeding 4 feet, with a minimum 1 ½” wide 26-gauge steel band to support flex. Maximum allowable sag is ½” per foot of spacing between supports.
20. Flexible duct shall be installed such that obstructions do not crush, distort or otherwise intrude on the flexible duct.
21. Contractor shall not provide holes in the duct systems for the installation of hangers for other equipment. Work of all other trades shall be so coordinated as to render this unnecessary.
22. At ends of ducts that are not connected to equipment, ductwork, or air distribution devices at time of ductwork installation, provide a temporary closure of plywood or corrugated cardboard backed polyethylene film or other covering that will prevent entrance of moisture, dust, and debris and duct leakage until time connections are to be completed.
23. Manufactured duct connectors shall be installed in strict accordance with the manufacturer's instructions. Material of duct connector shall match ductwork material.

B. Installation of Exposed Ductwork:

1. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
2. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
3. 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.
4. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
5. Repair or replace damaged sections and finished work that does not comply with these requirements.
6. Provide wire mesh over open ducts that do not receive grills, registers or diffusers.

3.2 DUCT PROTECTION

A. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction."

B. Store duct sections on jobsite in clean, dry area, on pallets or otherwise elevated from floor or grade. Duct ends and openings shall be covered and protected from dirt and moisture.

C. Cover and protect duct openings from dirt and moisture during and after erection.

D. Cover return ducts openings with MERV 8 filters whenever air handlers are operated during construction.

3.3 DUCTS

A. Seal ducts to the Seal Class described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." as follows:

1. Exterior, Supply, Return, or Exhaust Air Ducts, all pressure classes: Seal Class A.
2. Interior, Supply, Return, Outside, or Exhaust Air Ducts 2” w.g. (500 Pa) and Lower: Seal Class B.
3. Interior, Supply, Return, Outside, or Exhaust Air Ducts. greater than 2” w.g. (500 Pa): Seal Class A.
4. Other environmental air and comfort conditioning ductwork: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Install hangers and supports for metal ducts and fittings to comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Attachments and Spacing:

1. Building Attachments: Verify attachment methods with structural drawings. Use concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
2. Where practical, install concrete inserts before placing concrete.
3. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
4. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
6. Do not use powder-actuated concrete fasteners for seismic restraints.
7. Hanger Spacing: Comply with SMACNA for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection unless more restrictive by SMACNA.
8. Hangers Exposed to View: Threaded rod and angle or channel supports.
9. 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.
10. 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 DAMPERS

A. Install control dampers furnished by Division 23Section "Instrumentation and Controls for HVAC," at locations shown on drawings.

B. Install backdraft and control dampers on exhaust fans as near the building envelope exit as possible, unless otherwise indicated on drawings.

3.6 CONNECTIONS

A. Provide flexible and fabric connections at inlet and discharge duct connections to in-line fans, fan coil units and air handling equipment, except when fans are internally isolated. Flexible connections shall be securely fastened to the duct and equipment per SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Allow at least 1 inch (25-mm) of slack.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. 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.

C. Leakage Tests: Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.

3.8 DUCT CLEANING

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances. Where ductwork is to be painted clean and prepare surface for painting.

B. Ductwork contaminated or damaged above "shop" or "mill" conditions shall be cleaned, repaired or replaced to the Engineer's satisfaction.

1. Duct liner pre-installed in stored duct which has become wet may be installed if first allowed to completely dry out.
2. Duct liner in installed ductwork which has become wet must be completely removed and replaced.
3. Torn duct liner may be repaired by coating with adhesive if damage is minor and isolated. Extensively damaged liner shall be replaced back to a straight cut joint.

C. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts: Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

1. Pressure Class: Positive 1” w.g. (250 Pa).

C. Return and Outdoor Air Ducts: Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

1. Pressure Class: Negative 1” w.g. (250 Pa).

D. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel
2. PVC-Coated Ducts: Match duct material
3. Stainless steel Ducts: Match duct material
4. Aluminum Ducts: Aluminum
5. Internal reinforcement is prohibited in duct with design velocity over 2250 fpm, or on any grease exhaust duct, or any material handling duct.

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows." Use radius elbows unless specifically shown otherwise. Offsets shall be radius ogee fittings unless shown otherwise, mitered offsets shall not exceed 30 deg, and shall be without vanes.

   a. Radius Type RE 1 with minimum 1.5 radius-to-width ratio.
   b. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," with 1-1/2-inch spaced and 2-inch radius, small single width vanes and Figure 2-4, "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 shall be 1.5 and elbow segments shall be 5: Elbows with less than 90-degree change of direction have proportionately fewer segments.
   b. Radius-to Diameter Ratio: 1.5.
   c. Round Elbows, 12 inches and Smaller in Diameter: Stamped or pleated.
   d. Round Elbows, 14 inches and Larger in Diameter: Standing seam or Welded.

F. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connections."

    a. Rectangular Main to Rectangular Branch: 45-degree entry, or pyramidal where flow is from/to more than one direction.
    b. Rectangular Main to Round Branch: Conical spin-in.
    c. Branch to Run Out: Conical spin-in with damper.

        1) No dampers on air terminal inlet duct.

2. Round: 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.

    a. Velocity to 1500 fpm: Conical tap.
    b. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 3100

SECTION 23 3400 – FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

1.2 SUBMITTALS

A. Product Data: Product data for selected models, including specialties, accessories, certified fan performance curves, certified fan sound power ratings, motor ratings, and electrical characteristics.

B. Shop Drawings: Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

C. Wiring Diagrams: Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.

D. Seismic Control Data: Submit all required information by the Delegated Design Professional in responsible charge of design for Seismic Controls for this project. Where Section 23 0548, “Wind, Seismic, and Vibration Controls for Mechanical Systems” does not indicate any required seismic controls, no such submittal is required.

E. Wind Resistance Data: For all systems and equipment installed outdoors, submit shop drawings indicating the design of the supports and curbs, the attachments to supports and curbs, and the attachment of the support and curbs to the structure, slab, or grade as required to provide resistance to the wind forces identified in specification section 23 05 48, “Wind, Seismic, and Vibration Controls for Mechanical Systems”. Where there is no product of this section installed outdoors, no such submittal is required.

1.3 QUALITY CONTROL

A. Certificates: Fans shall bear the AMCA Certified Sound Ratings Seal.

PART 2 - PRODUCTS

2.1 FANS (GENERAL)

A. Provide fans that are factory fabricated and assembled, factory tested, and factory finished, with indicated capacities and characteristics.

B. Fans and shafts designed for continuous operation at the maximum rated fan speed and motor horsepower. The fan shaft shall be turned, ground, and polished steel designed to operate at no more than 70% of the first critical speed at the top of the speed range of the fan's class.

C. Provide type of shaft bearings indicated, having a median life "Rating Life" (AFBMA L10) of 200,000 hours, calculated in accordance with Anti-Friction Bearing Manufacturer's Association (AFBMA) Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.

D. All 3-phase fan motors 1 hp through 200 hp shall be NEMA Premium. Reference Division 23 Section "Common Work Results for HVAC" for additional motor requirements. Fan motors shall be selected so that they do not operate in the service factor at total pressures ±20% from selection point.

2.2 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Acme, Carnes, Greenheck, Jenn Fan, Loren Cook, Penn Ventilator, and Twin City Fan and Blower.

B. Belt-drive or direct-drive, as indicated, centrifugal shall consist of housing, wheel, fan shaft, bearings, motor, drive assembly, curb base, and accessories.

C. Housings shall be heavy-gauge, removable, spun-aluminum, dome top with outlet baffle; base shall be square, one-piece, hinged, aluminum with venturi design fan inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains. Upblast units used for kitchen/grease hood exhaust shall be UL 762 listed for application with approved grease reservoir and drain.

D. The fan wheel shall be aluminum hub and wheel with backward-inclined blades.

E. Belt-driven drive assembly shall be resiliently mounted to the housing, with the following features:

1. Pulleys: Cast iron, adjustable pitch.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
4. Fan and Motor: Isolated from exhaust airstream.

F. Provide the following accessories where scheduled on the drawings.

1. Disconnect Switch: Non-fusible type, with thermal overload protection, factory-wired through an internal conduit.
2. Bird Screens: Removable 1/2-inch mesh, 16-gauge, aluminum or brass wire.
3. Counter-balanced, parallel-blade, backdraft dampers with blade seals mounted in curb base, factory-set to close when fan stops.
3. Motor-operated, parallel-blade, shut-off dampers with blade seals mounted in curb base.

a. Blades shall be die-formed sheet aluminum with waterproof blade seals.
b. Frame shall be galvanized steel.

c. Linkage shall connect blades to counter weight or operator.
d. Motor actuator shall be two-wire spring-return type, same voltage as the fan motor, or shall be provided with a pre-wired step-down transformer.

4. Roof Curbs: Prefabricated, heavy-gauge, galvanized steel; mitered and welded corners; 2-inch-thick , rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks with 2-inch wood nailer. Size as required to suit roof opening and fan base.

a. Coordinate curb materials and construction with roof deck materials. Other curb heights or curbs for sloped roofs may be required.
b. Overall curb height shall be a minimum of 12 inches.

2.3 FINISHES

A. The following factory finishes are required:

1. Sheet Metal Parts: Prime coating prior to final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.4 SOURCE QUALITY CONTROL

A. Test fans in accordance with AMCA Standard 300, "Test Code for Sound Rating."

B. Fans and shafts shall be statically and dynamically balanced.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fans level and plumb in accordance with manufacturer's written instructions.

B. Arrange installation of units to provide access space around fan for service and maintenance.

C. Mount or suspend units on vibration isolators and secure to withstand overturning and seismic forces.

D. Design criteria for the fan-mounting system shall be capable of handling not less than 300 ft-lbs of torque. The fan shall be installed so that the fan blades are at least 10 feet above the floor or as shown. The fan installation area must be free of obstructions such as lights, cables, sprinklers, or other building components; with the blades at least 2 feet clear of all obstructions. The fan shall not be installed where it will be continuously subjected to wind gusts or in close proximity to the outputs of HVAC systems or radiant heaters.

E. If guy wires are needed, review structural attachments for the guy wires with the Structural Engineer. Provide factory authorized representative for startup and to assist the Balancing Contractor

3.2 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

3.3 CLEANING

A. Adjusting, Cleaning, and Protecting: Adjust damper linkages for proper damper operation. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

END OF SECTION 23 3400

SECTION 23 3600 – 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 Specifications, apply to this Section.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical and performance data for all air terminal units:

1. Submittal data for each air terminal unit shall include:

   a. Primary air inlet size
   b. Primary air design cfm as scheduled
   c. Primary air maximum airflow without exceeding specified sound levels
   d. Primary air minimum cfm as scheduled
   e. Primary air minimum controllable airflow

2. Submittal data for each fan-powered unit shall also include:

   a. Type of fan speed control
   b. Unit discharge airflow with fan or high speed
   c. Minimum airflow delivered at lowest fan speed setting

3. Submittal data for each chilled beam unit shall also include:

   a. Sound data in eight octave bands indicating sound at the scheduled operation conditions. Sound data shall be compiled by an independent testing laboratory.
   b. Heating and cooling capacities, pressure drops and flow rates.
   c. Primary air pressure drop.
   d. Total air flow.
   e. All data shall be corrected for project altitude.

B. Wiring Diagrams: Submit wiring and control diagrams for air terminal units.

C. Seismic Control Data: Submit all required information by the Delegated Design Professional in responsible charge of design for Seismic Controls for this project. Where Section 23 0548 “Wind, Seismic, and Vibration Controls for Mechanical Systems” does not indicate any required seismic controls, no such submittal is required.

1.3 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers: Anemostat, Carnes, Carrier, ETI, Krueger, Nailor, Metal Aire, Price, Titus, Trane, and Tuttle & Bailey.

2.2 VARIABLE AIR VOLUME

A. Casing: 0.034-inch steel sheet metal.

1. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
2. Lining: 1/2-inch-thick , coated, fibrous-glass or cotton duct liner complying with ASTM C 1071; secured with adhesive.

B. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, 3% of nominal airflow at 6-inch w.g. inlet static pressure.

C. Hot-Water Heating Coil: Copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig ; and factory installed.

D. Electric Heating Coil: Slip-in-type, open-coil design with integral control box factory wired and installed. Include the following features:

1. Primary and secondary overtemperature protection.
2. Nickel chrome 80/20 heating elements.
3. Fan interlock contacts.
4. Noninterlocking disconnect switch.
5. Fuses (for coils more than 48 A).
6. Mercury contactors.
7. Pneumatic-electric switches and relays.
8. Magnetic contactor for each step of control (for 3-phase coils).

E. All terminal units shall be pressure independent type. Terminal unit capacities and configuration shall be as scheduled on the drawings. Units shall have factory catalog performance ratings that match or exceed those indicated on the drawing schedules.

F. Terminal units shall have flow taps with calibration chart on unit for airflow measuring and balancing.

G. Provide quick-opening gasketed-type access door(s) as required to permit access to all internally mounted devices which may require adjustment, lubrication, and/or replacement, such as volume controllers, damper actuators, fans and motors, etc.

H. Air terminals shall be selected so required dB sound levels are not exceeded at 1.5-inch w.g. inlet pressure. Both unit casing radiated sound levels and discharge sound levels shall be considered in terminal unit selection.

I. All terminal units with electrical components shall incorporate a single point electrical connection for the entire unit. All electrical components shall be UL listed and installed in accordance with the National Electric Code.

1. All line voltage electrical components shall be mounted in a NEMA 1 enclosure.
2. The entire assembly shall be UL or ETL listed.
3. On units with fans or electric coils, provide a Class II 24V (ac), 40 VA transformer for control power.

J. Variable Air Volume Terminal Units:

1. Configuration: Volume-damper assembly inside unit casing with control components located inside a protective metal shroud.
2. Maximum wide-open static pressure requirement for box shall be 0.35-inch w.g .
3. Maximum flow (and minimum flow rates on VAV units) shall be field-adjustable.
4. Shall have cross type averaging flow element in primary air inlet for air volume control.

2.3 TEMPERATURE CONTROLS

A. Provide DDC controls including all actuators and controllers in accordance with Section 23 09 13 Instrumentation and Controls. Terminal unit controls may be factory mounted and wired at the contractor's option.

B. Refer to the drawings for Sequence of Operation descriptions.

2.4 ACCESSORIES

A. Electric heating coils, where used, shall be of the capacity and electrical characteristics scheduled on the drawings.

1. The coils shall include integral control panel, control contactors, terminal blocks for power and control connections, 24-volt control transformer, automatic reset thermal cutout, airflow lockout switch, secondary protection with manual reset or replaceable heat limiter, and subcircuit fusing when required by NEC.
2. All coils with greater than 12°F temperature rise shall be two-stage or as scheduled.

B. Terminal units shall be supplied with sound attenuator as scheduled.

1. Attenuator Section: 0.034-inch steel sheet metal.

a. Lining: 1/2-inch-thick , coated, fibrous-glass or cotton duct liner complying with ASTM C 1071; secured with adhesive.

2.5 SOURCE QUALITY CONTROL

A. Terminal units shall be tested and rated in accordance with ARI 880 "Industry Standard for Air Terminals" and shall bear the ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Support terminal units from structure using threaded rod and brackets. Install terminal unit to allow complete access to controls. Mount fan powered boxes with Specification “G” isolators in Division 23 Section 23 05 48 “Wind, Seismic, and Vibration Controls for Mechanical Systems”

B. Inlet branch duct(s) shall be rigid medium-pressure duct with a minimum of 3 feet of straight duct ahead of unit inlet(s).

1. Arrange medium-pressure ducts and takeoffs so there are no more than two elbows or bends up to 90-degrees in branch duct to inlet(s); "U" bends will not be allowed.

C. Water Coil Piping Connections: Provide shut-off valves, P & Ts, flow measurement and balancing valve, drain and air vent, and as further detailed on drawings.

D. Provide a minimum of 5 feet of lined low-pressure ductwork prior to first spin-in fitting or supply air outlet branch duct takeoff.

E. Coordinate terminal unit installation with the building DDC system contractor.

END OF SECTION 23 3600

SECTION 23 3700 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

1.2 DEFINITIONS

A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.

B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

C. Register: A combination grille and damper assembly over an air opening.

1.3 SUBMITTALS

A. Product Data:

1. For each model indicated, include the following:

   a. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
   b. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
   c. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
   d. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.

2. Provide sufficient submittal data for air distribution devices to verify that required space sound levels will not be exceeded.

1.4 SYSTEM DESCRIPTION

A. Performance Criteria: All equipment and material furnished under this section shall be selected so required RC sound levels in various spaces are not exceeded. Attenuation by ceilings, duct liner, and room absorption may be taken into account when making fan, terminal unit, and air distribution selections. Refer to the latest edition of the ASHRAE Applications Handbook for further information.

PART 2 - PRODUCTS

2.1 GRILLES, REGISTERS, AND DIFFUSERS

A. Approved Manufacturers: Anemostat, Carnes, Carrier, Krueger, Metal Aire, Nailor, Price, Tempmaster, Titus, Trane, and Tuttle & Bailey.

B. Air outlets and inlets shall be performance tested and rated in accordance with and ASHRAE Standard 70 "Method of Testing for Rating the Performance of Air Outlets and Inlets."

C. Provide grilles, registers, diffusers, slots, and accessories of size and type as indicated and/or scheduled on the drawings. Select devices so required space RC sound levels are not exceeded.

D. All grilles, registers, and diffusers shall have white baked-on enamel finish.

E. Provide ceiling grilles, registers, and diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. (Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling diffuser.)

1. Provide trim frames on all surface mount diffusers installed in gypsum board construction.

2.2 LOUVERS

A. Approved Manufacturers: Air Balance, Airstream, American Warming and Ventilating, Arrow, Creative Metals, Dowco Corp., Greenheck, Louvers & Dampers, Inc., Penn Ventilator Co., Ruskin, and Vent Products.

B. All louvers shall be tested in accordance with AMCA Standard 500 and shall bear the AMCA Certified Ratings Seal for both air performance and water penetration.

C. Size and location as shown and/or scheduled on the drawings.

D. Fixed Blade Aluminum Louvers:

1. Extruded aluminum
2. Invisible vertical mullions
3. Box frame with sill extension 6 inches thick. Drainable blades with downspouts (6 inches)
4. 3/4-Inch aluminum expanded metal bird screen with removable formed aluminum channel frame mounted on dry side
5. Finish, color by Architect.
6. 48" x 48" louver shall have approximately 8 square feet of free area (50%).
7. Equal to Ruskin ELF 6375 DX (6-inch, drainable)

2.2 INTAKE AND RELIEF HOODS

A. Approved Manufacturers: Acme, Carnes, Cook, Greenheck, Louvers and Dampers, Penn Ventilator, and Vent Products.

B. Hoods shall be selected for a maximum air pressure drop of 0.1" w.g. for intake and 0.05" w.g. for exhaust applications.

C. Hoods shall bear AMCA seals for rated airflow performance.

D. Finish shall be standard mill finish.

E. Hood construction shall be heavy-duty aluminum or galvanized sheets with rolled interlocking hood seams. Galvanized steel hood supports shall provide reinforcement. Airshaft vertical seams shall be continuously welded.

F. Hoods shall be "low profile design" and shall be specifically designed for the intended use.

1. Hoods shall have expanded aluminum or galvanized metal bird screen, 85% minimum free area.
2. Throat sizes shall be the same sizes as connected duct sizes shown on the drawings.
3. Relief hoods shall have outlet area a minimum of twice the throat area.

G. Intake hoods shall be furnished with 2-inch-thick aluminum expanded metal cleanable filters. Intake area shall be sized to limit filter velocity to 375 fpm and provide a maximum pressure drop (clean) of 0.06 inch.

H. Provide 12-inch-high insulated roof curbs for all intake and relief hoods.

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. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Grilles, Registers, and Diffusers:

1. Grilles, registers, and diffusers shall be installed level and plumb and supported per manufacturer's recommendations and per the International Building Code.

a. Ceiling-mounted air devices (supply diffusers and/or return and exhaust grilles and registers) or services weighing less than 20 pounds shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
b. Devices or services weighing 20 pounds, but not more than 56 pounds, in addition to the above, shall have two 12-gauge hangers connected from the device or service to the ceiling system hangers or to the structure above. These wires may be slack.

c. Air devices or services weighing more than 56 pounds hall be supported directly from the structure above by approved hangers.

2. Ductwork visible behind grilles, registers, and diffusers shall be painted flat black.
3. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
4. Refer to architectural reflected ceiling plan for locations of grilles, registers and diffusers.

B. Louvers:

1. Louvers shall be installed per architectural details and/or the manufacturer's recommendations.
2. Frames shall be caulked weather-tight to structure using approved material from Division 07.

C. Intake and Relief Hoods:

1. Install of roof curb with counterflashing. Coordinate with roof installer.
2. Fasten hood to roof curb to prevent overturning.

3.3 ADJUSTING

A. Grilles, Registers, and Diffusers: Throw patterns (directions) shall be furnished and/or adjusted to match those shown and/or scheduled on the drawings.

END OF SECTION 23 3700

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

1.2 SUBMITTALS

A. Product Data: Include manufacturer's technical data for each model indicated, including:

1. Rated capacities of selected models clearly indicated
2. Fan performance, including performance data showing brake horsepower, rpm, and static pressure characteristics from minimum flow to at least 125% of design flow.
3. Dimensions
4. Required clearance
5. Shipping, installed, and operating weights
6. Furnished specialties and accessories
7. Motor data (rpm, frame, efficiency, service factor, and voltage/current)
8. Damper construction and leakage rates
9. Installation and start-up instructions.

B. Sound Data by Octave Band:

1. Sound power levels at 5 feet from exterior of unit with no obstruction (dB)
2. Sound power levels at unit return air opening excluding roof curb (dB)
3. Sound power levels at unit supply air discharge opening excluding roof curb (dB)

C. Seismic Control Data: Submit all required information by the Delegated Design Professional in responsible charge of design for Seismic Controls for this project. Where Section 23 0548, “Wind, Seismic, and Vibration Controls for Mechanical Systems” does not indicate any required seismic controls, no such submittal is required.

D. Wind Resistance Data: For all systems and equipment installed outdoors, submit shop drawings indicating the design of the supports and curbs, the attachments to supports and curbs, and the attachment of the support and curbs to the structure, slab, or grade as required to provide resistance to the wind forces identified in Section 23 0548, “Wind, Seismic, and Vibration Controls for Mechanical Systems”. Where there is no product of this section installed outdoors, no such submittal is required.

E. Shop Drawings:

1. Submit shop drawings from manufacturer detailing equipment components and assemblies, indicating dimensions, weights, required clearances, location and size of field connections, and hoisting and mounting provisions.
2. Submit edited wiring diagrams that detail power and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring. Identify control interface points.

3. Rooftop units: Detail mounting, securing and flashing of roof curb to roof assembly. Indicate coordinating requirements with roof membrane system.

F. Start-up Reports: Indicate results of start-up and testing requirements. Submit copies of checklists.

G. Close-out Submittals: Operation and Maintenance Manual, specific to the unit being furnished, shall include:

1. Complete technical description of operation of the unit
2. Complete setup instructions
3. Troubleshooting guide
4. Complete parts list with part number identification
5. A list of recommended spare parts with pricing

1.3 1.3 QUALITY ASSURANCE

A. ARI Compliance:

1. Water source units shall have been rated in accordance with applicable portions of ARI and ISO Standard ARI 320, ARI-ISO-13256-1.
2. Sound ratings shall be per ARI Standard 270-95.

B. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Start-up."
2. Comply with ASHRAE 52.1 for arrestance and ASHRAE 52.2 for MERV for methods of testing and rating air filter units.

C. Rooftop units shall be UL listed and shall meet UL standard for rain resistance (no moisture penetration during 12-inches-per-hour rainfall).

D. All factory wiring shall be in accordance with NEC and NEMA requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver rooftop units as factory-assembled units with protective crating and covering.

B. Coordinate delivery of units in sufficient time to allow movement into building.

1.5 SYSTEM START-UP

A. The manufacturer shall provide start-up and testing service/assistance.

1.6 WARRANTY

A. Refer to Section 23 0500, “Common Work Results for HVAC," for general warranty requirements.

B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.

1. Warranty Period, Compressors: Manufacturers standard, but not less than 5 years after date of Substantial Completion.
2. Warranty Period, Heat Exchangers: Manufacturers standard, but not less than 10 years after date of Substantial Completion.

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. Obtain receipt from the Owner or Contractor that an extra set of filters has been provided.

1. One complete extra set of filters for each water to air unit in addition to those specified to be used during construction, start-up, and testing, and beneficial occupancy.
2. One spare set of belts for each belt-driven air handling unit; obtain receipt from Owner that belts have been received.
3. One spare set of gaskets for each door.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Water-source water to air heat pump units:

1. Aaon
2. Carrier Corporation
3. Climate Master, Inc.
4. Trane

2.2 ROOFTOP WATER-SOURCE HEAT PUMPS

A. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ARI-ISO-13256-1.

B. Cabinet and Chassis: Galvanized-steel casing with the following features:

1. Water and air-tight access panels for access and maintenance of internal components.
2. Knockouts for electrical and piping connections.

3. Flanged duct connections.
4. Cabinet Insulation: Glass-fiber liner, 1 inch thick, complying with UL 181.
5. Exterior Finish: Color selected by Architect from manufacturer's standard color selection.
6. Condensate Drainage: Plastic or stainless steel drain pan with condensate drain piping projecting through unit cabinet and complying with ASHRAE 62.1-2007.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

    a. Insulation in contact with airstream shall comply with ASTM C 1071, Type I or Type II.

8. Indoor Fan: Forward curved centrifugal, with direct-drive, multispeed motor resiliently mounted in fan inlet
9. General requirements for motors are specified in Section 23 05 00 "Common Requirements for HVAC Equipment."

C. Water Circuit:

1. Refrigerant-to-Water Heat Exchanger:
2. Coaxial, coil-in-shell, or shell-and-tube heat exchanger with copper or cupronickel water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount the heat exchanger in the unit on resilient rubber vibration isolators.

    a. Stainless steel brazed plate heat exchanger leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.

3. Motorized Water Valve: Stop water flow through the unit when compressor is off.

D. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig.

E. Refrigerant Circuit Components:

1. Sealed Refrigerant Circuit: Minimum of 2 circuits required for units 5 tons and larger. Intertwine circuits in refrigerant to air coil.

    a. Charge with R-407C or R-410A refrigerant.

2. Charging Connections: Service fittings on suction and liquid for charging and testing on each circuit.
3. Reversing Valve: Pilot-operated sliding-type valve designed to be fail-safe in heating position with replaceable magnetic coil.
4. Compressor: Hermetic reciprocating, hermetic scroll, semi-hermetic reciprocating compressor installed on vibration isolators housed in an acoustically treated enclosure with factory-installed safeties as follows:

    a. Anti-recycle timer.
    b. High-pressure cutout.
    c. Low-pressure cutout or loss of charge switch.

d. Internal thermal-overload protection.
e. Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 35°F.
f. Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.

5. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.
6. Pipe Insulation: Refrigerant minimum 3/8-inch-thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-development indexes per ASTM E 84.
7. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from 25 to 125°F.

F. Outdoor-Air Damper: Linked damper blades, for minimum 25% outdoor air, with manual slide and fully modulating, spring-return damper motor and hood.

G. Air-Side Economizer: Return-, relief-, and outdoor-air dampers with neoprene seals and with weather-resistant hood.

1. Damper Motors: Fully modulating spring return with adjustable minimum position potentiometer.
2. Temperature Control: Microprocessor-based controller using outdoor-air, mixed-air and outdoor-air temperature to adjust mixing dampers with water-loop entering temperature greater than 70°F. Delay opening outdoor-air damper to minimum position until room thermostat is satisfied at room set point temperature.
3. Ventilation Control: Provide carbon dioxide sensor to reset minimum outdoor-air intake rate.
4. Powered Relief: Direct-drive propeller fan with PSC motor, normally closed motorized damper, and hood.

H. Roof Curb: Steel, with corrosion-protection coating, gasketing, and factory-installed wood nailer; complying with NRCA standards; minimum height of 8 inches above the finished roof surface, including crickets.

I. Comply with Section 23 0548, "Wind, Seismic, and Vibration Controls for Mechanical Systems".

J. Control equipment and sequence of operation are specified in Section 23 0913 "Instrumentation and Controls for HVAC" and Section 23 0993 "Sequence of Operations."

K. Controls:

1. Basic Unit Controls:

a. Low- and high-voltage protection
b. Overcurrent protection for compressor and fan motor
c. Random time delay, three to ten seconds, start on power-up
d. Time delay override for servicing
e. Control voltage transformer
f. Duct-mounted temperature sensor.
g. LED to indicate fault condition at heat pump.

h. Data entry and access port.

1) Input data include room temperature and humidity set points for occupied and unoccupied periods.
2) Output data include room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

2. BAS interface requirements as further described in Section 23 0913 "Instrumentation and Controls for HVAC" and Section 23 0993 "Sequence of Operations."

a. Interface relay for scheduled operation.
b. Interface relay to provide indication of fault at central workstation.
c. Provide BAC-net interface for central BAS workstation for the following functions:

1) Set point adjustment for set points identified in this Section
2) Start/stop and operating status of heat-pump unit
3) Data inquiry to include supply air, room air temperature and humidity, and entering-water temperature
4) Occupied and unoccupied schedules

L. Electrical Connection: Single electrical connection with fused disconnect.

2.3 FILTERS

A. Provide all water to air heat pumps with the following filters:

1. Air filters shall be medium efficiency, pleated, disposable type, 1-inch thick. Each filter shall consist of media, media support grid, and enclosing frame. The filter shall be listed by Underwriters' Laboratories as Class 2.
2. Filter media shall be lofted, non-woven cotton fabric or glass fiber. The filter media shall have a MERV 7 rating in accordance with ASHRAE Test Standard 52.2.
3. The area ratio of effective filter media to filter face area shall be not less than 1.9 and shall contain not less than 15 pleats per linear foot. Initial resistance at 500 fpm approach velocity shall not exceed 0.2” w.g..
4. The enclosing frame shall be constructed of a rigid, heavy-duty, high wet-strength beverage board, with diagonal support members bonded to the air entering and air exit side of each pleat, to ensure pleat stability. The inside periphery of the enclosing frame shall be bonded to the filter pack to eliminate the possibility of air bypass.

2.4 HOSE KITS

A. General: Hose kits shall be designed for minimum 400 psig working pressure, and operating temperatures from 33 to 211°F. Tag hose kits to equipment designations.

B. Components:

1. Hose: Length 24 inches. Minimum diameter, equal to water-source heat-pump connection size. Stainless steel braid hose suitable for installation in return air plenum.

2. Isolation Valves: Two-piece bronze-body ball valves with stainless steel ball and stem and galvanized-steel lever handle. Provide valve for supply and return. The isolation valve may be an integral part of the strainer and/or automatic balancing valve.
3. Strainer: Y-type with blowdown valve in supply connection.
4. Hayes Mesurflo Flow, or approved equal automatic balancing valve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of water-source heat pumps.

B. Examine roughing-in for piping and electric installations for water-source heat pumps to verify actual locations of piping connections and electrical conduit before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Concrete Bases: Install floor mounting units on 4-inch-high concrete bases. See Section 23 05 00 "Common Work Results for HVAC" for concrete base materials and fabrication requirements.

B. Mount vibration isolators and seismic restraints. Vibration isolators and seismic restraints are specified in with Section 23 05 48, "Wind, Seismic, and Vibration Controls for Mechanical Systems."

1. Floor-mounted units shall be supported on concrete bases with vibration isolators. Secure units to anchor bolts installed in concrete bases.
2. Suspend water-source heat pumps from structure with threaded steel rods and vibration isolators.
3. Roof Curb: Install on roof structure or concrete base, level and secure. Coordinate with roofing installer. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07 Section "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts. Secure units to curb support with anchor bolts.

C. Install wall-mounting thermostats, humidistats, and switch controls in electrical outlet boxes at heights to match lighting controls or as required in Section 23 0913 "Instrumentation and Controls for HVAC" and Section 23 0993 "Sequence of Operations."

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Connect heat-pump condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against the pressure of fan, or install waterless trap. Install cleanouts in piping at changes of direction.

B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts. Specific connection requirements are as follows:

C. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

D. Install piping adjacent to machine to allow service and maintenance.

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 START-UP SERVICE

A. Engage a factory-authorized service representative to perform start-up service.

B. Do not operate air handlers until pre-filters are in place. One set of pre-filters shall be utilized during the construction phase and One set of pre-filters shall be utilized during the testing and balance phase. The final (third) set shall be installed after all construction is complete, spaces served are clean, and the HVAC system(s) are ready for "beneficial use" by the Owner or occupants with the spare set turned over to Owner.

C. Complete installation and start-up checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to compressor, coils, and fans.
2. Inspect internal insulation.
3. Verify that labels are clearly visible.
4. Verify that clearances have been provided for servicing.
5. Verify that controls are connected and operable.
6. Verify that filters are installed.
7. Adjust vibration isolators.
8. Inspect operation of barometric dampers.
9. Verify bearing lubrication on fan.
10. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
11. Adjust fan belts to proper alignment and tension.
12. Start unit according to manufacturer's written instructions.
13. Complete start-up sheets and attach copy with Contractor's start-up report.
14. Inspect and record performance of interlocks and protective devices; verify sequences.
15. Operate unit for an initial period as recommended or required by manufacturer.
16. Verify thermostat and humidistat calibration.
17. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
18. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
19. Start refrigeration system and measure and record the following:

    a. Coil leaving air, dry and wet bulb temperatures
    b. Coil entering air, dry and wet bulb temperatures
    c. Outdoor air, dry bulb temperature
    d. Outdoor air coil, discharge air, dry-bulb temperature
    e. Supply air volume
    f. Return air volume
    g. Relief air volume
    h. Outdoor air intake volume

3.6 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.7 CLEANING

A. Replace filters used during construction prior to air balance or substantial completion.

B. After completing installation of exposed, factory-finished water-source heat pumps, inspect exposed finishes and repair damaged finishes.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain water-source heat pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 8146

SECTION 26 0500 - BASIC ELECTRICAL MATERIALS-METHODS

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.

C. Division 26 Contractor shall be responsible for all work indicated by Divisions 26, 27, 28, and the electrical portions of Division 33 within the drawings and specifications. Any work indicated by Division 16 shall be provided and installed by the Division 26 Contractor.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Mechanical equipment motors to be furnished under another Division but connected under this Division. 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.

1.3 QUALITY ASSURANCE

A. Do all work in accordance with regulations and design and construction standards of the University of Utah, National Electrical Code, state and local codes and amendments, National Fire Codes, and all other applicable codes.

1.4 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 Engineer 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 Engineer.

E. Verify the physical dimensions of each item of electrical equipment to fit the available space and promptly notify the Engineer 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.

1.5 SHOP DRAWINGS

A. Prior to ordering equipment, and prior to Contractor's first application for payment, the Contractor shall, within 14 days after award of this work, submit six (6) complete shop drawings, neatly bound in 3-ring binder form, with indexed tabs, to the Architect, of materials and equipment he proposes to furnish. It is preferred that all sections be submitted at once, however, in the event that one or more sections need approvals quickly and others are not prepared yet, the Engineer will agree to review the individual section submittals needing immediate approval. However, each individual submittal section must be complete and remaining submittals that are not a rush shall be submitted all in one package as quickly as possible. Submitting individual sections over many weeks/months will not be tolerated.

B. 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.

C. See individual sections within this Division for products requiring submittal.

D. 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. Yellow highlight will not be an acceptable means of marking.

E. 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.

F. 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.

G. Contractor agrees that Shop Drawing Submittals processed by the Engineer are not Change Orders; that the purpose of Shop Drawing Submittals by the Contractor is to demonstrate to the Engineer 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.

H. 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 Engineer, the design Drawings and Specifications shall control and shall be followed.

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.

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 Engineer for clarification if this occurs.

D. All equipment for essential or life safety systems must be rated and certified for the appropriate seismic design category or seismic use group for the installed location.

2.2 DISCONNECTS

A. Safety and disconnect switches to be Heavy duty quick-make, quick-break, dual rated, lockable, and of such electrical characteristics as required for the load served. Switches to have defeatable cover interlock.

B. Fuse clips shall accept Class L fuses if required. Motor rated toggle switches equal to Square D Class 2510, type F with thermal overloads may be used as motor disconnects in dry locations.

C. Disconnect switches required by code shall be installed whether or not specifically shown on the Drawings. Disconnect switches for refrigeration equipment and multiple motor HVAC equipment shall be fusible type.

D. Safety and disconnect switches (fuse, non-fuse or circuit-breaker type) to be of same manufacturer as switchgear and panelboards.

2.3 FUSES

A. Provide fuses as indicated on the drawings, sized per NEC, or as required by the equipment manufacturer, whichever provides maximum protection, for a fully operational system.

B. All fuses shall be furnished of the same manufacturer.

C. All fuses shall be installed by the electrical contractor at job-site and only when equipment is to be energized. Fuses shall not be installed during shipment.

D. All fuses to be 200,000 AIC, Current-limiting, U.L., Time Delay, Dual-element Type as follows:

For feeders 600 Amps and less:

Class RKk-1 for 600 volt; LPS-RK, LLS-RK, & A6D-R
Class RK-1 for 250 volt; LPN-RK, LLN-RK, & A2D-R
Class J; JHC, JTD, & AJT

For motor circuits beyond the main and sub distribution boards, 600 volt and below:

Class RK-5 for 600 volt; FRS-R, FLS-R, & TRS-R
Class RK-5 for 250 volt; FRN-R, FLN-R, & TR-R

E. SPARE PARTS: Provide 10% spare fuses, but not less than 3 of any one size and type.

F. Approved Manufacturers, with catalog numbers listed in order: Bussman, Littelfuse, Ferraz Shawmut.

G. If the electrical contractor wishes to furnish materials other than those specified, a written request, along with a complete short circuit and selective coordination study, shall be submitted to the engineer for evaluation at least 8 days prior to the bid date. If the engineer's evaluation indicates acceptance, a written addendum will be issued listing the other acceptable manufacturer.

2.4 BOXES

A. Outlet and junction boxes shall be sized in accordance with code requirements or as noted on the drawings.

B. Unless otherwise specified or shown on the drawings, all outlet boxes for new work shall be galvanized steel knockout, outlet boxes. Gangable boxes are not acceptable. Outlet boxes shall not be smaller than 4 inch square and 1-1/2 inches in depth, unless otherwise noted. All outlet box covers, rings, or other fittings shall be galvanized. Boxes which are exposed to the weather shall be cast metal. Outlet boxes for phone and data outlets shall be 2.5-inch-deep boxes.

C. Outlet boxes shall be designed for the intended use, and shall be installed flush with finish surface lines or not more than 1/8 inch back and shall be level and plumb. Long screws with spaces or shims for mounting devices are not acceptable. No combustible materials shall be exposed to wiring at outlets.

D. Outlet boxes on opposite sides of fire or sound isolating partitions shall have a minimum horizontal separation of 24 inches. Back to back boxes are not permitted in any walls.

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 Engineer. 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 Engineer. 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, or as listed below, the Interior Elevations and drawing notes taking precedence. Where no heights are indicated, request clarification from the Engineer. Consult the Architectural, Mechanical and Structural drawings to avoid conflicts prior to roughing-in and for exact locations. All dimensions are to the top of the back box or device whichever is higher. Lighting dimensions are to the bottom of suspended fixtures and center of wall mounted fixtures unless otherwise noted.

Light Switches	48 inches to top
Convenience Receptacles	20 inches to top
Data/Telephone Outlets	20 inches to top
Disconnects and Motor Controllers	72 inches to top
Fire Alarm Signals	96 inches to top (but at least 6 inches below ceiling)
Fire Call Stations	48 inches to top

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 Code Authority having jurisdiction.

I. All materials and equipment installed under this work shall be properly and adequately supported from the building structure except where ceiling construction or other provisions are specifically

designed to support them. Support systems shall provide a safety factor of four. This shall apply to chains, hangers, anchors, clamps, screws, structural iron, and all other hardware and appurtenances associated with the support system.

J. Rough-in for communications outlets for phone and data systems shall consist of a 4" square deep (4SD) box with a single gang mud ring. Provide a .75-inch conduit for wall phones and a 1-inch conduit for combination voice and data outlets to an accessible ceiling space. Conduit shall be terminated above the ceiling in a bushing and a pull string installed.

K. Maintain the following minimum separations from voice and data cables:

1. Power conduit – 12 inches
2. Transformers and motors – 40-inches
3. Fluorescent lighting – 12 inches.

Coordinate with the voice and data installer to assure these separations are met.

3.2 LOW VOLTAGE WIRING METHODS

A. Provide Conduit homeruns complete for all low-voltage systems. Plenum cabling will not be acceptable.

B. Conductors shall be concealed by conduit in all spaces and shall be run parallel to structural lines and supported at minimum 10' intervals from structure.

C. All low voltage cable must be suitable for the conditions in which it will be used. Prior to purchasing or installing any cable, confirm with the Mechanical Contractor which areas, if any, require plenum rated cable.

D. Provide a box, plaster ring, and conduit with insulated bushing from each wall or floor outlet to an accessible ceiling or crawl space. Conduit shall be minimum 3/4" for telephone, minimum 1" combined voice and data outlets, and sized as needed for other systems. Drawings notes shall take precedence. Raceways for phone and data cable shall be sized based on the number of cables in accordance with the following guidelines.

3/4 inch conduit ..... max 4 cables
1 inch conduit ..... max 8 cables
1.25 inch conduit ..... max 14 cables
1.5 inch conduit ..... max 19 cables
2 inch conduit ..... max 32 cables

E. Furnish and install all necessary sleeves and raceways to permit the installation of signal cables (specific attention is called to non-contiguous ceiling spaces) to the appropriate equipment termination point. Provide sleeves through all fire-rated walls and partitions. No outlets of any type shall be left without a raceway system or accessible ceiling path to their termination point. Verify that raceway sizes and quantities are appropriate and will have at least 50% spare capacity after all cables are initially installed. Provide at least one empty spare conduit to each area, sized to handle future needs.

3.3 LABELING

A. Clearly and properly label the complete electrical system to indicate the loads served or the function of each item of equipment provided under this work.

B. Permanent Engraved nameplates: shall be 1/16 inch thick, laminated three-ply plastic, center-ply white, outer-ply black (for normal power) or red (for emergency power) or orange (for UPS power) "Lamicoid" or equal. Letters shall be formed by engraving outer colored ply, exposing white center-ply, and shall be a minimum of 5/8 inch high. Nameplates shall be secured with screws or pop rivets.

C. Provide permanent engraved nameplates for the equipment listed below as well as all other similar equipment; refer to each section for specific labeling requirements:

1. Switchboards and Panelboards
2. Motor Controllers, Variable Frequency Drives (VFD), Safety Disconnects
3. Electrical Contactors and Relays
4. Other similar electrical devices and equipment

D. Self-Adhesive Labels: shall have self-adhesive “P-Touch” or equivalent sticky backs, black lettering with a clear (see through) background.

E. Provide self-adhesive labels for the devices and equipment listed below as well as all other similar equipment; each label shall list the applicable circuit number feeding the device and devices fed from Emergency or UPS power shall also list “EMERGENCY” or “UPS” as applicable next to the circuit number (for example, a receptacle fed from circuit 2 in panel 1P1 would read “1P1-2” on the label):

1. Thermal Switches and Manual Starters
2. Power outlet receptacles
3. Light Switches, and Wall Mount timeswitches
4. Fire alarm initiation devices (smoke detectors, heat detectors, pull stations, etc.)
5. Fire alarm notification devices (horn/strobes, etc.)

F. For Service switchboards, panelboards, and/or disconnecting means, provide a permanent engraved label indicating maximum available fault current as calculated by the Engineer. Include the date calculation was made.

G. Where existing service entrance components are modified, including where conductors are increased in size, or the service transformer or service disconnecting means is replaced or increased in size, provide a new permanent engraved label on each service switchboard, panelboard, and/or disconnecting means with required information as indicated by the National Electrical Code.

H. Provide neat and clearly legible handwritten labeling using a permanent “Sharpie” or equivalent chisel tip black marker for all junction boxes containing power and fire alarm wiring. Label each junction box with the applicable circuit number(s) for the cables contained within each junction box in a location and large enough to be clearly visible from the floor.

I. Provide a laminated copy of the electrical one line diagram(s), size of sheets as required to be clearly visible. Permanently mount within main electrical room, coordinate final location with architect.

J. Where changes are made in existing panels, distribution boards, etc., provide new labeling and schedules to accurately reflect the changes.

3.4 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.

3.5 DEMOLITION

A. It is the intent of these specifications to require the contractor to make all necessary adjustments to the electrical system, required to meet code, and accommodate installation of the new and remodeled work.

B. Remove all existing fixtures, clocks, switches, receptacles, raceways, and other electrical equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless specifically shown as retained or relocated on the drawings. If existing walls, ceiling, floors, etc. are moved, extend existing devices, fixtures, and circuiting to the new location.

C. Disconnect all existing mechanical equipment scheduled for removal or relocation. See mechanical drawings for scope of work. Remove abandoned raceways and cables. Relabel panels and motor control centers to reflect changes.

D. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, new conduit and wire shall be provided to bypass the abandoned outlets. If existing conduits pass through or are mounted on partitions or ceilings which are being removed or remodeled, new conduit and wire shall be provided to route around the ceiling or wall and maintain service to the existing load.

E. Extend circuiting and devices in all existing walls to be furred out.

F. Locations of items shown on the drawings as existing are partially based on as-built and other drawings which may contain errors. Contractor shall verify the correctness of the information shown prior to bidding and provide such labor and material as is necessary to accomplish the intent of the contract documents. The plans may show some demolition conditions, but are not intended to show all of them.

G. All materials accumulated during the demolition process are the Owners property and shall be removed from the job site as directed by the Owner. If Owner does not wish to salvage materials, contractor shall remove from jobsite and dispose, or recycle materials at contractor’s discretion, in a lawful manner.

H. Where changes are made in existing panels, distribution boards, etc., provide new labeling and schedules to accurately reflect the changes.

I. Demolish and dispose of hazardous materials in a lawful manner, such as PCB containing transformers or ballasts, mercury containing lamps, or materials containing lead. All costs for proper disposal shall be paid by the contractor unless specified elsewhere in the general conditions.

3.6 POWER INTERRUPTIONS

A. Keep outages to occupied areas to a minimum and prearrange all outages with the Owner's representative and utilities involved. Requests for outages shall state the specific dates and hours and the maximum durations, with the outages kept to these specified times. When power interruptions will last longer than 5 minutes and cover more than 10% of the building, or affect public areas, they shall be performed on the weekends between 1 and 5 a.m.

B. Contractor shall coordinate with the Owner so that work can be scheduled not to interrupt operations, normal activities, building access, etc. Coordinate work with other crafts for proper scheduling.

C. No circuits shall be turned off without prior approval from owner. Coordinate with the Owner any interruptions which affect the operation of the remaining portions of the facility.

D. This contractor will be liable for any damages resulting from unscheduled outages or for those not confined to the preapproved times. Include all costs for overtime labor as necessary to maintain electrical services in the initial bid proposal. Temporary wiring and facilities, if used, shall be removed and the site left clean before final acceptance. Requests for outages must be submitted at least 5 days prior to intended shutdown time.

E. Include in bid cost of minimum temporary power for Fire Alarm System, Security, Telephone/Data equipment and any other equipment designated by Owner, during time when primary building power has been interrupted.

3.7 GROUNDING

A. Ground all electric equipment, raceways and enclosures in accordance with code rules and established safety practices. Provide a single main grounding point where grounding conductors from the Grounding Electrode System ground rods, ground grids, water pipes, main switchgear, etc. may be terminated.

B. Grounds shall be installed where accessible for future inspection and servicing. Where ground connections are made underground or in inaccessible locations, they shall be made using an exothermic weld process, Cadweld or equivalent or Ampact pressure connectors.

C. Install grounding conductors in approved metallic raceways unless specifically shown or specified otherwise. Bond at each end and at all intervening boxes and enclosures between the service equipment and grounding electrode.

D. No. 8 and smaller grounding conductors shall have green insulation. No. 6 and larger shall be marked with green colored tape at each end and at every box, panel, switchboard, or point where conductor is accessible.

E. All isolated ground buses shall be used only for conductors from isolated ground receptacles. Do not bond conduit or enclosures to isolated ground buses. All isolated ground conductors shall be run back to the main ground point for the separately derived system which serves them.

3.8 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.

3.9 SEISMIC BRACING

A. Furnish and install all seismic bracing of equipment, feeders, lighting fixtures, and other electrical items in accordance with prevailing codes. Refer to ASCE 7-05, section 13.6 for calculation methods. Provide and submit the required designs, calculations, certifications, and stamped drawings to the authority having jurisdiction and obtain their approval prior to installation or fabrication.

B. Where conduit, cable trays, or busducts are attached to structures where they cross a seismic isolation interface, the electrical components shall be designed to accommodate the seismic relative displacement.

3.10 PAINTING

A. All electrical equipment and conduit exposed in finished areas and on exterior walls are to be painted to match surrounding surfaces.

B. Contractor shall coordinate the timing of painting requirements.

C. Refer to Architectural specifications for methods and materials.

3.11 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: 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.

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. See Division 01 for additional requirements.

3.12 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.

3.13 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.

3.14 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. Engineer will make final inspection as soon as possible after receipt of Certification.

C. Should Engineer consider that work is finally complete in accordance with Contract Document requirements, Contractor shall make Contract Closeout submittals.

D. Should Engineer consider that work is not finally complete:

1. He will so notify Contractor, stating reasons.
2. Contractor shall take immediate steps to remedy deficiencies, and send second written notice to Engineer certifying that work is complete.
3. Engineer will re-inspect work.

E. The Engineer will make two final inspections. The first will determine deficiencies and errors in the work and the second will determine whether or not the noted deficiencies and errors have been satisfactorily corrected.

F. 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 Engineer. Charges will be based as follows:

1. Engineer time at current billing rates.
2. Travel time, and all other expenses incurred in making inspections.

G. Contractor to provide one (1) journeyman, tools, meters, instruments and other test equipment required by Engineer. Contractor to remove and replace trims, covers, fixtures, etc., for Engineer 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 26 0500

SECTION 26 0519 - WIRES AND CABLES (600V)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all wires and cables as herein specified and shown on the associated drawings for service conductors, feeder conductors and branch circuit conductors.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Basic Electrical Material & Methods – Section 26 0500.

B. Raceways – Section 26 0533.

1.3 QUALITY ASSURANCE:

A. All wire and cable shall meet or exceed the following standards:

1. ASTM-B series specifications
2. ICEA S-61-402/NEMA WC 5 - Thermoplastic insulated cables 0-2000 volt
3. UL Standard 62 and 83 – Thermoplastic insulated cable
4. UL VW-1 Flame Test for sizes #12 through #1
5. National Electric Code (NFPA 70) – Latest edition

B. Manufacturer's shall be engaged in the manufacturing of industry accepted quality wires and cables for a period of no less than 5 years for all types and sizes required.

1.4 SUBMITTALS

A. None required.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide products of Southwire, Houston Wire, Rome Cable, or similar manufacturer located within the continental North American market. Cables made in Europe, Asia, South America, Africa, or other overseas markets are not acceptable.

B. Substitutions: Equivalent manufacturers are allowed at contractors option, no submittals or prior approvals are necessary if cable meets specifications.

2.2 MATERIALS

A. Application: For use in general wiring applications for lighting and power in ducts, conduits, wireways and other approved raceways with a maximum conductor temperature of 90 degrees C in dry locations and 75 degrees C in wet locations.

B. Provide wires and cables that are chemical, gasoline, and oil resistant.

C. Minimum conductor size shall be No. 12 AWG unless otherwise noted.

D. Where adverse conductor exposure exists, code approved insulation suitable for the conditions encountered shall be used unless shown otherwise on the Drawings.

E. Wire and cable shall be new, shall have grade of insulation, voltage and manufacturer's name permanently marked on outer covering at regular intervals and shall be delivered in complete coils or reels with identifying size and insulation tags.

2.3 COPPER CONDUCTORS

A. For No. 10 AWG and smaller, provide soft-drawn stranded copper conductors with type THHN/ THWN insulation.

B. For No. 8 AWG and larger, provide soft drawn stranded, Class B stranded copper conductors with type THHN/THWN insulation.

2.4 ALUMINUM AND/OR METAL CLAD (MC) CABLING OPTIONS

A. Aluminum and MC Cabling not acceptable – Provide copper only conductors.

2.5 COLOR CODE

A. All wire shall be fully colored in sizes 12 and 10 AWG, and color banded at each end and at all junction and pull boxes for size 8 AWG and larger.

B. Color Code throughout the project shall be:

1. 480Y/277V System

Phase A	Brown
Phase B	Orange
Phase C	Yellow
Neutral	Grey
Neutral A (dedicated)	Grey w/black stripe #12 & #10
Neutral B (dedicated)	Grey w/orange stripe #12 & #10
Neutral C (dedicated)	Grey w/yellow stripe #12 & #10
Equipment Ground	Green

2. 208Y/120V System

Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Neutral A (dedicated).....	White w/black stripe #12 & #10
Neutral B (dedicated).....	White w/red stripe #12 & #10
Neutral C (dedicated).....	White w/blue stripe #12 & #10
Equipment Ground.....	Green
Isolated Ground.....	Green w/yellow stripe #12 & #10
.....	Green and Yellow bands #8 and up

C. Provide a permanent, plastic engraved label on the inside of each branch-circuit panelboard throughout the project identifying the Color Code used throughout the project. Refer to NEC 200.6 (D).

2.6 SPLICES AND TERMINATIONS

A. Splices shall utilize Scotch "Hyflex" or "Ideal" wing nut connector installed properly. Crimp on splices designed to be used without wire stripping are not acceptable.

B. Splices for No. 8 and larger wires shall be made with mechanically applied pressure type connectors.

C. All taped joints shall be with "Scotch 33+" or equal, applied in half-lap layers without stretching to deform.

D. Where splice box is subject to rain, weather, or moisture, provide “Rain Tight” termination device.

E. Terminations of conductors passing through “high heat zones”, shown on the drawings, shall be 90°C rated lugs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspect exposed cables for physical damage and remove as length allows.

B. Utilize pulling compound on long pulls.

C. Do not exceed manufacturer’s minimum bending radius or tension during installation.

D. Provide dedicated neutrals on all branch power receptacle circuits of 120/208 volt.

3.2 BRANCH CIRCUIT GROUNDED CONDUCTOR (NEUTRAL) WIRING METHODS

A. Dedicated (separate) neutral wiring methods

1. Provide dedicated neutral wiring for the following system(s):

   a. Lighting
   b. Receptacles
   c. Other than lighting and receptacle branch circuits
2. Provide dedicated (separate) neutral for each branch circuit; shared/common neutral wiring is not allowed.
3. For dedicated neutral branch wiring, there shall be no more than six (6) current-carrying conductors allowed within a single raceway unless specifically allowed otherwise in the drawings. All neutral conductors shall be considered current carrying. Provide all required wire size increases to account for the applicable NEC wire ampacity deratings.
4. Provide dedicated neutral cables with colored stripe as required in wire color coding section for identification.

3.3 SPLICES AND TERMINATIONS

A. Splices are to be made up complete promptly after wire installation.

B. Single wire pigtails shall be provided for fixture and device connections. Wirenuts may be used for fixture wire connections to single wire circuit conductor pigtails.

C. Install wing nut connector properly, according to manufacturers written instructions. Crimp on splices designed to be used without wire stripping are not acceptable.

D. Torque bolted connections to manufacturers recommendations.

E. Insulation shall be removed with a stripping tool designed specifically for that purpose. A pocket knife is not an acceptable tool. All conductors shall be left nick-free.

F. Thermoplastic insulated wire and cable shall not be installed or handled in temperatures below +14°F (-10°C). Cross-linked polyethylene insulated wire and cable may be installed to -°F (-40°C).

3.4 LABELING

A. Service Cables - Provide an engraved laminated 3-ply plastic “Lamicoid” or equal label which designated as “SERVICE CABLE(S)” attached with a nylon wire tie to the cables at each entry and exit from pullboxes, wireways and any other similar locations.

B. Feeders – Provide an engraved laminated 3-ply plastic “Lamicoid” or equal label with feeder name attached with a nylon wire tie to the feeder at each entry and exit from pullboxes, wireways and any other similar locations.

C. Branch Circuits – Clearly mark and identify the circuit number(s) at each junction box and similar location with a permanent black marker or equivalent that is clearly visible. For concealed junction

boxes the marking shall be made on the outside coverplate; for exposed boxes or boxes with finished coverplates marking shall be made on the interior of the box where visible when removing the coverplate.

3.5 COMMISSIONING AND TESTING

A. Contractor shall provide for access and inspection of installed wires and cables by the Architect/Engineer, owner and commissioning agent.

B. Document all tests and provide written copies in the O&M manuals.

C. Perform continuity tests and resistance measurements through bolted connections to ensure correct cable connections.

D. Perform insulation resistance test on all feeder conductors exceeding 100 amps, size #2 and larger. Values shall not be less than 50 megaohms.

END OF SECTION 26 0519

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SECTION 26 0526 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all grounding and bonding as code required and as herein specified and shown on the associated drawings.

1.2 APPLICATION

A. All grounding and bonding shall be by copper only connectors, copper cable and wire, and/or copper braids.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Basic Electrical Material & Methods – Section 26 0500.

B. Wires & Cables – Section 26 0519.

1.4 QUALITY ASSURANCE

A. All installation of grounding and bonding conductors shall meet or exceed the following standards:

1. Exceeds ANSI/IEEE 142 for service ground electrode resistance (2.5 ohms rather than 5 ohms).
2. ASTM B 8 stranded conductors
3. ICEA S-61-402/NEMA WC 5 - Thermoplastic insulated cables 0-2000 volt
4. UL Standard 62 and 83 – Thermoplastic insulated cable
5. 4.UL VW-1 Flame Test for sizes #12 through #1
6. National Electric Code (NFPA 70) – Latest edition
7. UL listing is required

B. Manufacturers shall be engaged in the manufacturing of industry accepted quality grounding connectors for a period of no less than 5 years for all types and sizes required.

1.5 SUBMITTALS

A. None required.

PART 2 - PRODUCTS

2.1 GROUNDING CONNECTORS AND GROUND RODS

A. Acceptable Manufacturers: Subject to compliance with all requirements, provide products of one of the following manufacturers for grounding connectors or ground rods:

1. Chance/Hubbell
2. Copperweld Corporation
3. Erico Inc., Electrical Products Group
4. Burndy Electrical
5. Kearney/Cooper Power Systems
6. O-Z/Gedney Co
7. Raco/Hubbell
8. Thomas & Betts Electrical

B. Provide products of a quality manufacturer located within the continental North American market. Grounding connectors made in Europe, Asia, South America, Africa, or other overseas markets are not acceptable.

C. Provide products that are listed and labeled by UL for all applications used, and for specific types, sizes and combinations of conductors and other items connected.

D. For buried connections, provide crimp style connections or welded type connections. For accessible connections, provide bolted pressure-type, torque as per manufacturers recommendations.

E. Substitutions: Equivalent manufacturers are allowed at contractor's option, no submittals or prior approvals are necessary if ground connectors and rods meet specifications.

2.2 CONDUCTORS

A. Provide copper or tinned-copper wire and cable insulated for 600 volt unless otherwise required by applicable code or authorities with jurisdiction.

B. Provide No. 4 and/or No. 6 AWG stranded conductor for bonding conductors.

C. Bonding Jumper: Provide copper tape, braided copper conductors, terminated with copper ferrules, 1-5/8 inches wide and 1/16 inch thick.

PART 3 - EXECUTION

3.1 GROUNDING INSTALLATION

A. Ground all electric equipment, raceways and enclosures in accordance with code rules and established safety practices. All grounding systems inside the building must be bonded to the main power service ground, including telecom closets, TV cabling entrances, lightning protection systems, and computer data center grounds. es

B. Install insulated equipment grounding conductors in all types of raceways for all power feeders and branch circuits

C. Route grounding electrode conductors along the shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subject to strain, impact, or damage.

D. Grounding electrode conductors and bonding jumper connections to grounding electrodes shall be accessible (unless allowed by NEC 250.68(A) exceptions) and provide a continuous effective grounding path.

E. Where ground connections are made underground or in inaccessible locations, they shall be made using an exothermic weld process, Cadweld or equivalent, or Ampact pressure connectors.

F. Install main grounding electrode conductors in approved metallic raceways unless specifically shown or specified otherwise. Bond at each end and at all intervening boxes and enclosures between the service equipment and grounding electrode.

G. No. 8 and smaller grounding conductors shall have green insulation. No. 6 and larger shall be marked with green colored tape at each end and at every box, panel, switchboard, or point where conductor is accessible.

H. Provide bonding jumpers to steel structure as indicated on the plans. Use exothermic welded connectors for steel connections below slab, and/or bolted clamp connections where accessible above slab.

I. For equipment subject to vibration, install bonding jumper so that vibration is not transmitted through the grounding connection.

3.2 CONNECTIONS

A. For equipment grounding connections #10 and smaller, grounding conductors may be terminated with appropriate winged pressure type connectors (wirenuts). For #8 and larger, use pressure-type grounding lugs.

B. Where metallic raceways terminate at metal housings without appropriate electrical connection to housing, terminate each conduit with an insulated throat grounding bushing. Connect grounding bushing with a bare copper grounding conductor to grounding bus and/or grounding terminal electrically bonded to housing.

C. For all main telephone/data conduits and sleeves exceeding 1-1/2 inches, where serving telephone/data closets and data rooms, provide insulated throat grounding bushings. Connect grounding bushing with a bare copper grounding conductor to grounding bus inside telecom room.

D. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturers published torque-tightening values. If manufacturers data is not available, tighten according to UL468A.

E. For compression type connections, use hydraulic compression tools and dies to provide the correct circumferential pressure for all connectors. Use only tools and dies as recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible, permanent indication that a connector has been adequately compressed onto the grounding conductor.

3.3 COMMISSIONING AND TESTING

A. Contractor shall provide a time for access and inspection of grounding system for the Architect/Engineer, telecommunications installer and the commissioning agent. Correct all defects and flaws found prior to testing.

END OF SECTION 26 0526

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SECTION 26 0533 – RACEWAYS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all raceways, wireways, and associated fittings as herein specified and shown on the associated drawings.

1.2 APPLICATION

A. Electric metallic tubing (EMT), galvanized rigid conduit (GRC), intermediate metal conduit (IMC), flexible metal conduit, and PVC conduit may be used.

B. Schedule 40 PVC conduit may only be used below grade and below slabs on grade. PVC shall not be used above grade. PVC shall not be used in masonry walls and shall not be used in suspended slabs. Conduits larger than 1 inch may be run below the slab. Type EB and DB utility duct shall not be substituted for Schedule 40 PVC.

C. GRC and IMC shall be used in locations subject to mechanical injury, for penetrations of building and manhole walls, and for service conduit under concrete slabs. GRC and IMC may be used: outside, where exposed to weather, in wet locations, in hazardous locations (as approved by code). Schedule 80 PVC may not be substituted for GRC and IMC.

D. EMT may be used only in dry and protected locations and in suspended slabs. EMT may not be used: outside, where exposed to weather, in hazardous locations or where subject to mechanical injury.

E. Flexible metal conduit (FMC) will be permitted only where flexibility is necessary. FMC may be used only where flexibility is necessary in dry protected locations, such as: connections to recessed light fixtures, work fished into existing concealed dry locations, wood frame construction. Flexible metal conduit shall be used for connection to all equipment subject to movement or vibration such as motors and transformers. Length shall not exceed 6 feet unless specified otherwise.

F. Liquid-Tight Flexible Metal Conduit (LFMC) shall substitute only in those locations where flexible metal conduit is required and additional moisture protection is desired or needed. LFMC may be used: for connections to motors or fixed equipment where subject to moisture or weather and subject to movement or vibration. Length shall not exceed 6 feet unless specified otherwise.

G. Drawing notes requiring a specific type of raceway shall take precedence over the specifications.

H. Surface metal or Plastic raceways (Wiremold) shall not be used.

I. Electrical wiring shall be in U.L. approved raceways and enclosures throughout.

J. Conduits 4 inch and larger intended for use on primary services and communications services shall have minimum 48-inch radius sweep on all bends.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Basic Material & Methods – Section 26 0500.

B. Wires and cables (600V) – Section 26 0519.

1.4 QUALITY ASSURANCE

A. All installation of conduits and raceways shall meet or exceed the following standards:

1. Polyvinyl Chloride (PVC): in accordance with ANSI C80.1 and NEMA Std. Pub. No. RN 1.
2. Rigid Metal Conduit (RMC): in accordance with ANSI C80.1.
3. Electric Metallic Tubing (EMT): in accordance with ANSI C80.3.
4. Seismic Bracing: ASCE 7-05, Section 13.6, latest edition
5. National Electric Code (NFPA 70) – Latest edition
6. UL listing is required

B. Manufacturer's shall be engaged in the manufacturing of industry accepted quality raceway for a period of no less than 5 years for all types and sizes required.

1.5 SUBMITTALS

A. None required.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide products of a quality manufacturer located within the continental North American market. Conduit and Raceways made in Europe, Asia, South America, Africa, or other overseas markets are not acceptable.

B. Substitutions: Equivalent manufacturers are allowed at contractor's option, no submittals or prior approvals are necessary if conduit and fittings meet specifications.

2.2 RACEWAYS

A. Galvanized Rigid Metal Conduit (GRC): Provide zinc-coated, hot-dipped galvanized, rigid metallic conduit in sizes indicated on the drawings. Provide RMC in 3/4 inch minimum size.

B. Intermediate Metal Conduit (IMC): Provide hot-dipped galvanized, intermediate metal conduit in sizes indicated on the drawings. Provide IMC in ¾ inch minimum size.

C. Electric Metallic Tubing (EMT): Provide electric metal tubing in sizes indicated on the drawings. Provide EMT in ¾ inch minimum size.

D. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight, flexible metal conduit, constructed of single strip, flexible continuous, interlocked, and double-wrapped steel, galvanized inside and outside, coated with liquid-tight jacket of flexible Polyvinyl Chloride (PVC). Provide Liquid-Tight Flexible conduit in 3/4 inch minimum size.

E. Provide Schedule 40 PVC conduit (where installed below grade or below slab on grade) in one inch minimum size.

F. Surface metal raceways equal to Wiremold (700 series unless noted otherwise) may be used only where specifically called for on the drawings or in the specifications. Such installation shall be directed and approved by the Architect prior to ordering raceway.

G. Surface plastic raceways are not acceptable.

H. Aluminum conduit is not acceptable.

I. Provide EMT in 3/4 inch minimum size; EMT in 1/2 inch minimum size may be used for fire alarm and low voltage (< 30 volts) control wiring only.

J. Provide PVC conduit in one inch minimum size.

2.3 FITTINGS

A. EMT Connectors and couplings shall be steel concrete tight set screw type with insulated throats on connectors. Die-cast fittings or fittings made from pot metal shall not be allowed. Indenter type fittings are not acceptable

B. Connectors larger than 1-1/4 inch shall utilize equivalent of O-Z/Gedney type SBT/SB insulated bushings.

C. GRC and IMC shall be coupled and terminated with threaded fittings. Provide fully-threaded, malleable steel fittings, rain-tight and concrete-tight as applicable. Provide double locknuts and metal bushings at all conduit terminations. Ends shall be bushed with insulating bushings (OZ Gedney type B or equal).

D. PVC shall be provided with matching schedule 40 fittings.

E. FMC and LFMC fittings shall be in accordance to industry standards.

F. Sealing bushings are to be provided equal to O-Z/Gedney Type FSK, WSK or CSMI as required by application. Provide equal to O-Z/Gedney Type CSB for internal sealing busings.

G. Expansion fittings shall be equal to O-Z/Gedey AXDX.

H. Cable Supports: Provide OZ Gedney, or equivalent cable supports for vertical risers, type as required by application.

I. Aluminum conduit fittings are not acceptable.

2.4 SEISMIC BRACING COMPONENTS

A. Provide the following components for vertical support and lateral/longitudinal seismic bracing:

1. Strut: Unistrut (or equal) P1000 Metal Framing Channel
2. Allthread: Stainless Steel, 3/8 minimum size
3. Angles/Hinges: Bline B335-2 or Mason Industries SCB Swivel Anchor
4. Expansion Anchors: Hilti Kwik Bolt II (or equal) minimum 3/8" x 2-1/4" depth.
5. Hardware: Miscellaneous cap screw/spring nuts and other hardware required for a complete system.

2.5 BOXES

A. Refer to section 26 0500 for appropriate boxes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide pull boxes where shown or required to limit the number of bends in any run to not more than three 90 degree bends. Use code gauge galvanized sheet steel boxes of code required size with removable covers, installed so that covers will be accessible after work is completed. Verify with the Architect any locations in finished areas.

B. Exposed raceways shall be parallel to structural lines and location must be approved by Architect/Engineer prior to installation. Where exiting from masonry walls in exposed rooms, particular attention and detail should be taken to exit in a neat and orderly fashion, at the correct elevation to hit structural steel roof supports.

C. Avoid placing conduits within 1-1/2 inches of the upper flutes of roof decking.

D. Maintain a minimum of 6 inches spacing from Hot water and/or steam lines, and 2 inches from Chilled Water and Culinary Water lines. Do not support conduit from other utility services.

E. Conduits 4 inch and larger intended for use on primary services and communications services shall have minimum 48-inch radius sweep on all bends.

F. Conceal all raceways and wiring in finished spaces.

G. All conduit leaving building envelope (e.g., site lighting, roof mounted HVAC requirement, etc.) to be 0.75 inch minimum.

H. Field bends and offsets shall be made without flattening, kinking, rippling or destroying the smooth internal bore or surface of the conduit and to not less than NEC minimum radius. Conduit that shows signs of rippling or kinking shall not be installed. Any conduits installed with wrinkles or kinks or otherwise in an unworkmanlike manner shall be replaced at no additional cost to owner.

I. Precaution shall be exercised to prevent accumulation of water, dirt, concrete, or other foreign matter in the conduits during the execution of the project. Conduits in which water or foreign matter has been permitted to accumulate shall be thoroughly cleaned or the conduits runs replaced where such accumulation cannot be removed by methods approved the engineer.

J. Permanently cap all spare conduits. Cap or plug conduit ends during construction to prevent entrance of foreign material.

K. For metal conduit systems, provide electrically continuous conduit systems throughout.

L. Conduit stubbed from a concrete slab or wall to serve an outlet under a table or to supply a machine shall have a rigid conduit coupling flush with the surface of the slab. Provide plug where conduit is to be used in future.

M. Conduits in above grade suspended slabs, where written approval is obtained from the Structural Engineer of Record, shall be located in the middle of the slab and spaced according to the minimum recommendations of the ACSE 9-91. There shall be no crossovers, and conduit must be spaced a minimum of 18 inches on center. Conduits larger than one inch shall not be run in suspended slabs.

N. If work in suspended slabs is approved, EMT must be placed on stands and tied down to prevent floating prior to concrete pour. A minimum of 1-1/2 inch of concrete cover below the conduit and above the conduit is required. The Architect/Engineer must be invited to review and approve the installation prior to the concrete pour. Contractor shall rework any conduit rough that is disapproved.

O. Avoid placing conduits in pre or post tensioned slabs. The maximum size, spacing, and location of conduits in pre or post-tensioned slabs shall be subject to approval by the Structural Engineer.

P. Provide ground wire within all conduits sized per NEC code.

3.2 SUPPORT AND SEISMIC BRACING INSTALLATION

A. Conduit racks shall be adequately braced for Seismic Restraint, as required per ASCE 7-05, Section 13.6, latest edition.

B. For 3 or more conduits install conduit racks with trapeze style hanging system, with stainless steel 3/8 inch all-threads hanging down to a Galvanized steel strut assembly. Provide conduit clips to rigidly clip conduit to strut.

C. Provide a diagonal lateral seismic restraint braces at maximum 10 foot intervals (alternating directions), and a longitudinal brace (alternating directions) at maximum 30 foot intervals. Braces must be made of strut or similar rigid material, and will be tied directly to trapeze strut with hinges or rigid angles. Wire ties for bracing will not be acceptable. All hardware made for bracing shall be seismically rated.

D. If a large number of suspended conduit feeders (more than 12 each exceeding 2-1/2 inches in size) are grouped together, the contractor shall review the layout with the structural engineer, provide estimated weights, and obtain approval for the proposed layout.

E. Hanger rods shall be fastened to structure in an approved manner. Pullout resistance shall have a safety factor of 4.

F. Support individual suspended feeder conduits by metal ring or trapeze hangers with threaded steel rods.

G. Support spacing shall be in accordance with the following table, in addition to these maximum spacing requirements the seismic support and bracing may require additional support and/or spacing supports less than the maximum distance indicated below; the most stringent requirement and shortest spacing distances shall be enforced.

Conduit Type	Conduit Size	Max. Distance Between Conduit Supports	Max. Distance from Outlet Box, Junction Box, Cabinet, Fitting, Conduit Termination or Bends Larger Than 22 Degrees
IMC/GRC	½” to ¾” 1” 1.25” to 1.5” 2” to 2.5” 3” and larger	10 feet 12 feet 14 feet 16 feet 20 feet	3 feet for all sizes
EMT	All Sizes	10 feet	3 feet
FMC	All Sizes	4.5 feet	1 foot
LFMC	All Sizes	4.5 feet	1 foot

3.3 FIELD CUTS AND THREADS

A. Cut all conduits perpendicular and square. Remove all sharp or rough edges and ream all burrs, inside and outside.

B. Provide clean sharp threads on RMC and IMC. Engage at least five full threads on all RMC and IMC fittings.

C. Before couplings or fittings are attached, apply one coat of red lead or zinc chromate to male threads of RMC or IMC.

D. Apply coat of red lead, zinc chromate or special compound recommended by manufacture to conduit where conduit protective coating is damaged.

3.4 EXPANSION AND SEISMIC JOINTS

A. Expansion Joints:

1. All conduits crossing expansion joints where cast in concrete shall be provided with expansion-deflection fittings, equivalent to O-Z/Gedney AXDX, installed per manufacturers recommendations.
2. All conduits three inches and larger where not cast in concrete shall be rigidly secured to the building structure on opposite sides of a building expansion joint with an expansion-deflection

fitting across the joint, equivalent to O-Z/Gedney AXDX, installed per manufacturer's recommendations.

3. All conduits less than three inches where not cast in concrete shall be provided with junction boxes securely fastened on both sides of the expansion joint, connected together with 15 inches of slack (a minimum of 15 inches longer than the straight line length) flexible conduit and copper green ground bonding jumper. In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits three inch and larger, may be installed.

B. Seismic Joints:
1. No conduits cast in concrete shall be allowed to cross a seismic joint.
2. All conduits shall be provided with junction boxes securely fastened on both sides of the seismic joint, connected together with 15 inches of slack (a minimum of 15 inches longer than the straight line length) flexible conduit and copper green ground bonding jumper. Prior to installation, verify with Architect that the 15 inches is adequate for the designed movement, and if not, increase this length as required.

3.5 CLEANING

A. Pull a mandril and swab through all conduits before installing conductors. Raceways shall be left clean and free of debris.

B. Provide a pull string in all empty conduits.

3.6 COMMISSIONING AND FINAL INSPECTION

A. Contractor shall provide a time for access and inspection of raceway system for the Architect/ Engineer, telecommunications installer and the owner. Correct all defects and flaws found prior to wall and ceiling installation and prior to cabling installation.

B. Demonstrate rigid seismic bracing to ensure minimal movement of the raceways on suspended racks in a seismic event. Demonstration shall be by pushing with at least 25 pounds force laterally and longitudinally at selected (mid-span) locations along the length of the suspended raceway rack. Rack shall not move more than 2 inches during these demonstrations.

END OF SECTION 26 0533

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SECTION 25 0526 – 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 Specifications, apply to this Section.

B. Refer to Division 26, Common Work Results for Electrical Systems.

C. Refer to Division 26, Vibration and Seismic Requirements for Electrical Systems.

1.2 ACTION SUBMITTALS

A. Product Data: Submit for each type of product. 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 trays, 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. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

    a. Vertical and horizontal offsets and transitions.
    b. Clearances for access above and to sides of cable trays.
    c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
    d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Delegated-Design Submittal: For seismic restraints.

1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer who is licensed in the state where Project is located and who is responsible for their preparation.
2. Design Calculations: Calculate requirements for selecting seismic restraints.
3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
2. Vertical and horizontal offsets and transitions.
3. Clearances for access above and to side of cable trays.
4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

B. Field quality-control reports.

1.4 COORDINATION

A. Coordinate layout and installation of cable trays and suspension system with other construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; a division of Atkore International
2. B-Line Systems, Inc.
3. Chalfant Cable Trays
4. Cope, a division of Atkore International, Inc.
5. Enduro Composites Inc.
6. GS Metals Corp.
7. Legrand North America, LLC
8. MP Husky USA Cable Tray
9. Thomas & Betts Corporation
10. Engineer-approved equal

2.2 GENERAL REQUIREMENTS FOR CABLE TRAY

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.

1. Source Limitations: Obtain cable trays and components from single manufacturer.

B. Structural Performance: See articles on individual cable tray types for specific values for the following parameters:

1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.

2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 WIRE-MESH CABLE TRAY

A. Description:

1. Configuration: Galvanized- steel wire mesh, complying with NEMA VE 1.
2. Width: 12 inches (300 mm) unless otherwise indicated on Drawings.
3. Minimum Usable Load Depth: 4 inches (100 mm)or as indicated on Drawings.
4. Straight Section Lengths: 12 feet (3.7 m), except where shorter lengths are required to facilitate tray assembly.
5. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
6. Maximum uniform load and support span are indicated by cable tray class.
7. Class Designation: Comply with NEMA VE 1, Class 12A or as indicated on the Drawings.
8. Splicing Assemblies: Bolted type using serrated flange locknuts.
9. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

B. Materials and Finishes:

1. Steel:

a. Straight Sections and Fittings: Steel complies with the minimum mechanical properties of ASTM A1008/A1008M, Grade 33, Type 2.
b. Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.
c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
d. Finish: Hot-dipped galvanized after fabrication, complying with ASTM A123/A123M, Class B2.
e. Hardware: Galvanized, ASTM B633.

2.4 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier Strips: Same materials and finishes as for cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.5 WARNING SIGNS

A. Lettering: 1-1/2-inch-(40-mm-)high, black letters on yellow background, with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

B. Comply with Division 26, Section "Identification for Electrical Systems."

2.6 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA FG 1 and NEMA VE 2.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

A. Install cable tray and support systems according to NEMA FG 1 and NEMA VE 2.

B. Install cable tray as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Install cable tray, so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Join aluminum cable tray with splice plates; use four square-neck carriage bolts and locknuts.

F. Fasten cable tray supports to building structure and install seismic restraints.

G. Provide fasteners and supports to carry cable tray, cables, and a concentrated load of 200 lb (90 kg). Comply with requirements in Division 26, Section "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to Division 26, Section "Vibration and Seismic Restraints for Electrical Systems."

H. Place supports, so that spans do not exceed maximum spans on schedules, and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of tray rungs.

I. 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.

J. Support assembly to prevent twisting from eccentric loading.

K. Do not install more than one cable tray splice between supports.

L. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

M. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed recommended dimensions. Space connectors and set gaps according to applicable standard.

N. Make changes in direction and elevation using manufacturer's recommended fittings.

O. Make cable tray connections using manufacturer's recommended fittings.

P. Seal penetrations through fire and smoke barriers.

Q. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

R. Install cable trays with enough workspace to permit access for installing cables.

S. Install barriers to separate cables of different systems, such as power, communications, and data processing, or of different insulation levels, such as 600, 5000, and 15,000 V.

T. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Division 26, Section "Grounding and Bonding for Electrical Systems."

B. Bond cable trays with electrical power conductors together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Bond cable trays with single-conductor power conductors together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inch (1800-mm) intervals. Size the grounding conductor according to NFPA 70.

D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding-bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70

3.3 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties. 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. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).

3.4 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect raceways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing cable trays survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items, such as pipes, hangers, or other equipment, in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 Ohm.

B. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 26 0536

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SECTION 26 0553 – 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 Specifications, apply to this Section.

B. Refer to Division 26, Common Work Results for Electrical Systems.

1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels.

C. Samples: For each type of label and sign to illustrate color, lettering style, and graphic features of identification products.

1.3 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 RACEWAY AND CABLE LABELS

A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

1. Color: Black letters on orange field.
2. Legend: Indicates voltage.

B. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

C. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.

1. Not less than 6 inches wide x 4 mil thick (152 mm wide x 0.102 mm thick).
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend indicating type of underground line.

D. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch-thick (0.4 mm) aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

E. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.

F. Aluminum-Faced, Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002-inch-thick (0.05-mm), laminated with moisture-resistant acrylic adhesive, punched for fasteners, and preprinted with legends to suit each application.

G. Brass or Aluminum Tags: 2 inch x 2 inch x 0.05 inch (51 mm x 51 mm x 1.3 mm) metal tags with stamped legend, punched for fastener.

2.2 NAMEPLATES AND SIGNS

A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, a minimum of 1/16 inch thick (1.6 mm) for signs up to 20 square inches (129 square cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with white letters on black face.
2. Punched or drilled for mechanical fasteners.

C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch (6.4 mm) grommets in corners for mounting.

D. Exterior, Metal-Backed, Butyrate Signs: 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 the application. 1/4 inch (6.4 mm) grommets in corners for mounting.

E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch (5 mm)

2. Tensile Strength: 50 lb (22.3 kg) minimum
3. Temperature Range: Minus 40 to plus 185°F (Minus 40 to plus 85°C)
4. Color: According to color-coding

B. Paint: Formulated for the type of surface and intended use.

1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Circuits with more than 600 volts: Identify raceway and cable with "DANGER--HIGH VOLTAGE" in black letters 2 inches (51 mm) high, stenciled with paint over a continuous, painted orange background; place warning signs at 10 foot (3 m) intervals. Identify the following:

1. Entire floor area directly above conduits running beneath and within 12 inches (305 mm) of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to conduits concealed within wall.
3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in the building, or concealed above suspended ceilings.
4. Entire surface of exposed conduits.

E. Install painted identification according to manufacturer's written instructions and as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.
2. Prime surfaces using type of primer specified for surface.
3. Apply one intermediate and one finish coat of enamel.

F. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:

1. Bands: Pretensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide (51 mm), completely encircling conduit, and place adjacent bands of two-color markings in contact, side-by-side.
2. Band Locations: 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.
3. Apply the following colors to the systems listed below:

   a. Fire Alarm System: Red
   b. Fire-Suppression Supervisory and Control System: Red and yellow
   c. Combined Fire Alarm and Security System: Red and blue
   d. Security System: Blue and yellow
   e. Mechanical and Electrical Supervisory System: Green and blue
   f. Telecommunication System: Green and yellow

G. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

H. Circuit Identification Labels on Boxes: Install labels externally.

1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover
2. Concealed Boxes: Plasticized card-stock tags
3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent

I. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm) overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

J. Secondary Service, Feeder, and Branch-Circuit Conductors: Color-code throughout the secondary electrical system.

1. Color-code 208/120-volt system as follows:

   a. Phase A: Black
   b. Phase B: Red
   c. Phase C: Blue
   d. Neutral: White
   e. Ground: Green

2. Color-code 480/277-volt system as follows:

   a. Phase A: Brown
   b. Phase B: Orange

c. Phase C: Yellow
d. Neutral: Gray or white with a colored stripe
e. Ground: Green with a gray stripe

3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:

a. Colored, pressure-sensitive plastic tape in half-lapped turns for a 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. Use 1-inch-wide (25 mm) tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches (76 mm) from the terminal and spaced 3 inches (76 mm) apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

K. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.

1. Legend: 1/4 inch (6.4 mm) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations
2. Tag Fasteners: Nylon cable ties
3. Band Fasteners: Integral ears

L. Apply identification to conductors as follows:

1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

M. Apply warning, caution, and instruction signs as follows:

1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch-high (9 mm) lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

N. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch-high (13 mm) lettering on

1-1/2-inch (38 mm) -high label; where two lines of text are required, use labels 2 inches (50 mm) high. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Panelboards, electrical cabinets, and enclosures
2. Access doors and panels for concealed electrical items
3. Electrical switchgear and switchboards
4. Emergency system boxes and enclosures
5. Motor-control centers
6. Disconnect switches
7. Enclosed circuit breakers
8. Motor starters
9. Power transfer equipment
10. Contactors
11. Control devices
12. Transformers
13. Clock/program master equipment
14. Fire alarm master station or control panel

O. Transformer Disconnecting Means Identification: where transformer disconnecting means is not in sight of transformer, or located in a remote location, the disconnecting means shall be lockable and its location shall be indicated on the transformer. Provide engraved-plastic labels to indicate location of transformer disconnecting means.

END OF SECTION 26 0553

SECTION 26 0923 – LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

B. Refer to Division 26, Common Work Results for Electrical Systems.

1.2 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 specifications. Any submitted device that differs in any manner from that specified must be marked "exception." Clearly indicate exact differences and include all manufacturers' data as indicated.

B. Product Data: including device operation, warranty period, wiring diagram(s), dimensions, materials, and finishes.

C. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

D. Submittals for Lighting controls Commissioning

1. Lighting controls Commissioning plan and reports
2. Lighting controls record construction documents
3. All required commissioning documentation

1.3 CLOSE-OUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Manufacturers indicated are used to establish a minimum acceptable standard of quality. Similar products by comparable manufacturers may be considered.

1. Time Switches:

    a. Intermatic
    b. Paragon
    c. TORK
    d. Or approved equal.

2. Outdoor Photoelectric Controls:

    a. Intermatic
    b. Paragon
    c. TORK
    d. Or approved equal.

3. Indoor Occupancy Sensors:

    a. Hubbell Building Automation
    b. Leviton Controls
    c. Sensor Switch
    d. Watt-Stopper Inc.
    e. Or approved equal.

4. Lighting Contactors:

    a. Allen-Bradley/Rockwell Automation
    b. Eaton Corporation.
    c. Schneider Electric
    d. Or approved equal.

5. Emergency Shunt Relays:

    a. Hubbell Building Automation
    b. Philips Bodine
    c. Sensor Switch
    d. Watt-Stopper Inc.
    e. Or approved equal.

6. Indoor Wall Switch Timers:

    a. Hubbell Building Automation
    b. Leviton Controls
    c. Sensor Switch
    d. Watt-Stopper Inc.
    e. Or approved equal.

2.2 TIME SWITCHES

A. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Configuration: Single pole single throw or single pole double throw as required or indicated.
3. Contact Rating: 30A inductive or resistive, 120/208/240/277V ac.
4. Programs: Up to fourteen on-off set points on a 24-hour schedule stored for life in non-volatile memory.
5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
6. Astronomic Time: Combinable to independent programs for ON sunset and OFF sunrise settings.
7. Automatic daylight savings time changeover.
8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.
9. Override Function: Program can be manually overridden by pushing on/off button on clock face.

2.3 INDOOR OCCUPANCY SENSORS

A. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20A ballast load at 120 and 277V ac, for 13A tungsten at 120V ac, and for 1 hp at 120V ac. Sensor has 24V dc, 150 mA, Class 2 power source, as defined by NFPA 70.
5. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
7. Bypass Switch: Override the "on" function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (20 to 2000 lux); turn lights off when selected lighting level is present.
9. Warranty: 5 years.

B. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch-minimum (150 mm) movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).

C. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

D. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum (150 mm) movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application and shall comply with California Title 24.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120°F (0 to 49°C).
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277V, and 1500W incandescent.
4. Standard Range: 180-degree field of view, with a minimum coverage area capable of sensing occupancy in a room up to 15 feet x 15 feet.
5. Sensing Technology: Provide PIR or dual-technology sensors to meet space sensing requirements.
6. Switch Type: selectable for manual ‘on’ or automatic ‘on’ at unit.
7. Voltage: match circuit voltage.
8. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 2 to 200 fc (20 to 2000 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
9. Concealed "off" time-delay selection from 30 seconds to 30 minutes with test mode.
10. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
11. Warranty: 5 years.

2.5 LIGHTING CONTACTORS

A. Description: Electrically operated and mechanically held, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, LED and high-inrush ballast (ballast with 15% or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on drawings, matching the NEMA type specified for the enclosure.

B. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors. Coordinate with BAS controls contractor.

1. Monitoring: On-off status
2. Control: On-off operation

2.6 EMERGENCY SHUNT RELAY

A. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: provide to match voltage of lighting circuit.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install equipment level and plumb and according to manufacturer's written instructions.

B. Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have 90 to 100% coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors.

C. Arrange a pre-installation meeting with the manufacturer's factory-authorized representative, at the Owner's facility, to verify placement of sensors and installation criteria.

D. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

E. Set time delay for all occupancy sensors to maximum 30 minutes.

F. Set Dual-Technology occupancy sensors to be activated by either infrared or ultrasonic technologies.

G. Mounting heights indicated are to bottom of unit for suspended devices and to center of unit for wall-mounting devices.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Install wiring between sensing and control devices according to manufacturer's written instructions and as specified in Division 26, Section 26 05 19, "Low-Voltage Electrical Power Conductors and Cables," for low-voltage connections.

B. Wiring Method: Install all wiring in raceway as specified in Division 26, Section 26 0533, "Raceways and Boxes for Electrical Systems."

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions. Bundle, train, and support wiring in enclosures

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

F. Ground equipment Connections

G. 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.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26, Section 26 0553, "Identification for Electrical Systems."

B. Label time switches and contactors with a unique designation. Identify controlled circuits in lighting contactors.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lighting control devices will be considered defective and shall be replaced if they do not pass tests and inspections.

D. Prepare test and inspection reports and submit to the Owner/Architect for review.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify that lighting is controlled to suit the Owner operations. Adjust sensitivity and time delay to suit the Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit the Owner's operations.

3.7 LIGHTING CONTROLS COMMISSIONING

A. Commission the lighting controls according to the requirements of the adopted edition of the International Energy Conservation Code along with local amendments.

B. Completed and certified by the Contractor’s registered design professional or approved agency

C. Include the following services:

1. Commissioning plan
2. Preliminary report of commissioning test procedures

    a. Acceptance of Report letter
    b. Preliminary Commissioning Report for review by the code official

3. Documentation Requirements

    a. Record construction documents
    b. O&M Manuals
    c. System maintenance and calibration information

4. Lighting System Functional Testing

    a. Functional Testing
    b. Occupant sensor controls
    c. Time-switch controls
    d. Additional testing as specified by the code official

5. Daylight Responsive Controls
6. Record construction documents

3.8 DEMONSTRATION AND TRAINING

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 26 09 43 "Relay-Based Lighting Controls".

B. Engage a factory authorized service representative to train the Owner's maintenance personnel as specified below:
    1. Train the Owner's maintenance personnel on troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of three hours' training.
    2. Training Aid: Use the approved final version of maintenance manuals as a training aid.

C. Schedule training with the Owner, through the Architect, with at least two weeks’ advance notice

END OF SECTION 26 0923

SECTION 26 2200 – LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

B. Refer to Division 26, Common Work Results for Electrical Systems.

1.2 REFERENCES

A. Equipment, methods, materials and procedures applicable to low voltage transformers shall be governed by the latest edition of the following standards or publications:

NFPA 70:	National Electric Code, National Fire Protection Association
10 CFR	Part 431.192 - Code of Federal Regulations, Energy Conservation Standards for Low-Voltage Dry-Type Distribution Transformers
	Part 431, Subpart K, Appendix A. - DOE Test-Procedure
ANSI/NEMA ST 20:	Dry-Type Transformers for General Applications, National Electrical Manufacturers Association
UL 1561:	Dry-Type General Purpose and Power Transformers, Underwriters Laboratory, Inc.
IEEE C57.12.91:	Test Code for Dry-Type Distribution and Power Transformers.
ANSI/NEMA TP-1:	Guide for Determining Energy Efficiency for Distribution Transformers (2002)
IEEE C57.110-1998:	IEEE Recommended Practice for establishing transformer capability when feeding non-sinusoidal load currents
IEEE-1100:	Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
IEEE-519-1992:	IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems

1.3 SUBMITTALS

A. Shop Drawings: Provide shop drawings for each different model transformer in accordance with Division 01. Shop drawings shall consist of the following:

1. Dimensional plan and elevation views (show base dimensions with anchoring recommendations.)
2. Conduit entrance locations and dimensions
3. Incoming and outgoing conductor terminator positions
4. Wiring terminal lug locations, and all other terminal lug locations, number, and size of wire per lug.
5. Neutral, ground bus connections
6. Weight of equipment
7. Minimum clearances
8. Wiring Diagrams: Detail wiring and identify terminals for tap changing and connecting field-installed wiring.

B. Product Data: Provide data sheets for each different model transformer in accordance with Division 01. Product data shall include the following:

1. Complete nameplate data including:

   a. kVA
   b. Primary and secondary voltage
   c. Primary and secondary ampere rating at all tap connections.
   d. Windings material.
   e. Insulation class and winding temperature rise.
   f. Impedance percent.
   g. Basic impulse insulation level.
   h. Connection diagram showing tap configuration.
   i. Manufacturers Model Number and UL label.

2. Model performance data including losses and efficiency at 25, 50, 75, and 100% rated load; and sound level.
3. Certification of UL listing and compliance with NEMA standards.
4. Efficiency when feeding loads at 100% and 50% of nameplate rating.
5. Harmonic performance when feeding computer loads at 50% of nameplate rating.
6. Copy of Factory nonlinear load test of a representative 75kVA transformer per manufacturer’s factory nonlinear load test program.

C. Product Certificates: Signed by manufacturers of transformers certifying that the products furnished comply with requirements.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

E. Factory Test Reports: Certified copies of manufacturer's design and routine factory tests required by referenced standards.

F. Sound-Level Test Reports: Certified copies of manufacturer's sound-level tests applicable to equipment for this Project.

G. Field Test Reports: Indicate and interpret test results for tests specified in Part 3.

H. Maintenance Data: For transformers to include in the maintenance manuals specified in Division 01.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: In addition to requirements specified in Division 01, an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907; or shall be a full-member company of the International Electrical Testing Association.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.

B. Listing and Labeling: Provide transformers specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

C. Comply with IEEE C2.

D. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store and protect products under provisions of Division 01 and in accordance with manufacturer's instructions.

B. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.

C. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect Units against entrance of rain, sleet, or snow if handled in inclement weather.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

1.7 WARRANTY

A. Transformer shall carry a 10-year pro-rated warranty standard.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide general purpose and power transformers by one the following:

1. Acme Electric Corp.; Transformer Division
2. Challenger Electrical Equipment Corp.; a division of Eaton Corp.
3. Controlled Power Company
4. Eaton Corp.; Cutler-Hammer Products
5. General Electric Co.; Electrical Distribution & Control Div.
6. Hammond Co.; Matra Electric, Inc.
7. Magnetek Power Electronics Group
8. Micron Industries Corp.
9. Myers Power Products, Inc.
10. Sola/Hevi-Duty Electric
11. Square D Co.; Schneider Electric USA
12. Siemens Industry, Inc.

2.2 TRANSFORMERS, GENERAL

A. Description: Factory-assembled and -tested, air-cooled quiet-type units of types specified, designed for 60-Hz service. Transformers shall be of the size, rating, and mounting configurations as shown on the drawings. Unless otherwise specified, the design, manufacture, and testing of dry-type transformers and the methods of conducting tests and preparing reports shall be in accordance with ANSI, IEEE, UL, and NEMA Standards. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40°C maximum ambient, with a 30°C average over 24 hours. The terminal compartment temperature shall not exceed 75°C when the transformer is operating continuously at rated load with an ambient temperature of 40°C. Transformers shall be provided with factory installed ground lug. Provide lifting eyes on brackets. Lift and label as complying with UL 1561.

B. Cores: Grain-oriented, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses, one leg per phase.

C. Coils: Continuous aluminum or copper windings without splices, except for taps. One coil per phase in primary and secondary.

D. Internal Coil Connections: Brazed or pressure type.

E. Enclosure:

1. Class complies with NEMA 250 for the environment in which installed.

a. Indoor ventilated, NEMA 250, Type 2.

2. The enclosure shall be made of heavy gauge steel and shall be finished utilizing a continuous process of degreasing, cleaning, and phosphatizing, followed by electrostatic deposition of a polymer polyester powder coating and baking. The coating color shall be ANSI 61. The enclosure shall have lifting holes. All ventilation openings shall be protected against falling dirt.

F. Low-Sound-Level Units: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

G. Enclosure: Indoor, ventilated NEMA 250, Type 2

H. Insulation Class: For general purpose and power transformers, 185 or 220°C class for transformers smaller than 15 kVA; 220°C class for transformers 15 kVA and larger. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

1. Rated Temperature Rise: 150°C maximum rise above 40°C, for 220°C class insulation. Maximum hot spot temperature of 30°C.

I. Taps: For transformers 3 kVA and larger, full-capacity taps in high-voltage windings are as follows:

1. Taps, 7.5 to 24 kVA: Two 5% taps below rated voltage
2. Taps, 25 to 500 kVA: Two 2.5% taps above and two 2.5% taps below normal full capacity

J. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with efficiency levels prescribed in 10 CFR 431.192.
2. Tested according to DOE Test-Procedure. 10 CFR Part 431, Subpart K, Appendix A.

2.3 FINISHES

A. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Design and routine tests comply with referenced standards.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project if specified sound levels are below standard ratings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with safety requirements of IEEE C2.

B. Arrange equipment to provide adequate spacing for access and for circulation of cooling air. Clearance from walls or other equipment shall be per manufacturer's recommendations, but not less than 6 inches.

C. Identification:

1. Identify transformers and install warning signs according to Division 26 Section "Identification for Electrical Systems."
2. Where transformer disconnecting means is not in sight of transformer, or located in a remote location, the disconnecting means shall be lockable and its location shall be indicated on the transformer. Provide engraved-plastic labels to indicate location of transformer disconnecting means.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

E. Transformers smaller than 15 kVA shall be wall-mounted using unistrut supports. Transformers 15 kVA and larger shall be floor-mounted unless otherwise shown on the drawings. Provide Korfund elasto-rib vibration isolations pads for all transformers, along with rubber washers for all mounting bolts. Where wall-mounted, provide factory mounting brackets. Where floor-mounted, install and anchor to 4-inch thick concrete pad. Set the transformer plumb and level.

F. Conduit connections to transformers shall be made with flexible metal conduit, not less than 18 inches or more than 36 inches in length. Where primary feeders come from the floor below, they shall terminate at the end of transformer enclosure with a metal grounding bushing with neoprene throat insert. Ground the bushing to the transformer enclosure.

G. Provide working space for all transformers.

1. The depth of the working space in the direction of live parts shall not be less than 4 feet measured from the enclosure.
2. The width of the working space in front of transformers shall be the width of the equipment or 30-inches, whichever is greater. All enclosure removable panels shall be capable of opening a minimum of 90 degrees.
3. The work space shall be clear and extend from the grade, floor, or platform to a height of 6½ feet or the height of the equipment, whichever is greater. Within the height requirements of this section, other equipment or support structures, such as concrete pads, associated with the electrical installation and located above or below the electrical equipment shall be permitted to extend not more than 6-inches beyond the front of the electrical equipment.
4. Where transformers are located in a space with limited access, all of the following shall apply:

   a. Where equipment is installed above a lay-in ceiling, there shall be an opening not smaller than 22-inches × 22-inches, or in a crawl space, there shall be an accessible opening not smaller than 22-inches × 30-inches.
   b. The width of the working space shall be the width of the equipment enclosure or a minimum of 30- inches, whichever is greater.
   c. All enclosure removable panels shall be capable of opening a minimum of 90 degrees.

d. The space in front of the transformer shall not be less than 4 feet measured from the enclosure. The maximum height of the working space shall be the height necessary to install the equipment in the limited space. A horizontal ceiling structural member or access panel shall be permitted in this space.

3.2 GROUNDING

A. Separately Derived Systems: Comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near the transformer.

B. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems," for materials and installation requirements.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to supervise the field assembly and connection of components, and the testing and adjusting of transformer components and accessories.

B. Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing.

C. Test Objectives: To ensure transformer is operational within industry and manufacturer's tolerances, is installed according to the Contract Documents, and is suitable for energizing.

D. Test Labeling: On satisfactory completion of tests for each transformer, attach a dated and signed "Satisfactory Test" label to tested component.

E. Schedule tests and provide notification at least 7 days in advance of test commencement.

F. Report: Submit a written report of observations and tests. Report defective materials and installation.

G. Tests: Include the following minimum inspections and tests according to manufacturer's written instructions. Comply with IEEE C57.12.91 for test methods and data correction factors. On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

1. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.
2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.
3. Insulation Resistance: Perform megohmmeter tests of primary and secondary winding to winding and winding to ground.

   a. Minimum Test Voltage: 1,000V, dc
   b. Minimum Insulation Resistance: 500 megohms

c. Duration of Each Test: 10 minutes
d. Temperature Correction: Correct results for test temperature deviation from 20°C standard

H. Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Verify that transformers meet specified requirements.

3.4 CLEANING

A. On completion of installation, inspect components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars on finish to match original finish. Clean all ventilation openings. Clean components internally using methods and materials recommended by manufacturer. Do not use compressed air to assist in cleaning.

3.5 ADJUSTING

A. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings and submit with test results.

END OF SECTION 26 2200

SECTION – PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

B. Refer to Division 26, Common Work Results for Electrical Systems.

1.2 SUBMITTALS

A. All exceptions to the specification shall be in written, detailed format with paragraphs referenced and presented with the shop drawing submittal. Refer to Division 01. Provide a written list with sections referenced of all the exceptions taken on this specification.

B. Product Data: For each type of panelboard, accessory item, and component specified.

C. Shop Drawings: For panelboards. Include dimensioned plans, sections, and elevations. Show tabulations of installed devices, available spaces, major features, and voltage rating. Include the following:

1. Enclosure type with details for types other than NEMA 250, Type 1
2. Bus configuration and current ratings
3. Short-circuit current rating of panelboard
4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components
5. Wiring Diagrams: Details of schematic diagram where applicable (i.e., shunt trip devices, breaker monitoring, metering, etc.), including control wiring and differentiating between manufacturer-installed and field-installed wiring
6. Quantity and wire range of lugs

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

G. Maintenance Data: For panelboard components to include in the maintenance manuals specified in Division 01. Include manufacturer's written instructions for testing circuit breakers.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: In addition to the requirements specified in Division 01, an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories,

Title 29, Part 1907, or shall be a full member company of the InterNational Electrical Testing Association.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. 2.Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

C. Comply with NFPA 70.

D. Panelboards:
1. NEMA PB-1
2. Federal Specification W-P-115A Type II, Class 1
3. UL 50 and 67

E. Circuit Breakers:

1. NEMA AB-1
2. Federal Specification W-C-375a and W-C-375b
3. UL 489

1.4 MAINTENANCE

A. Extra Materials: Keys: Six spares of each type for panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by the following:

1. Eaton Corp.
2. General Electric Co.; Electrical Distribution & Control Div.
3. Square D Co.; by Schneider Electric USA

2.2 FABRICATION

A. Enclosures: Flush- or surface-mounted cabinets as indicated. NEMA PB 1, Type 1, unless otherwise indicated to meet environmental conditions at installed location. Enclosures shall be corrosion resistant galvanized (zinc finished) sheet steel. Fronts shall be cold rolled steel, finish coated with ANSI 49 and 61 gray enamel over a rust inhibitor. Panel locks shall be keyed alike.

Recessed flush-mounted panels shall have overlapping front. All sections of multi-section panelboards shall be the same size.

B. Front for surface-mounted panelboards shall be same dimensions as box. Fronts for flush panelboards shall overlap box, unless otherwise indicated.

C. Directory Frame: Metal, mounted inside each panelboard door.

D. Bus System:

1. Bus bars shall be sequence phased, rigidly supported by high impact resistant, insulated supporting bus assemblies to prevent vibration and resulting damage when subjected to stress, vibration or short circuits. Solderless terminations shall be suitable for either copper or aluminum wire or cable.
2. Bus bars shall be tin-plated or silver-plated copper. Bus bars shall be of the ampere rating shown on the Drawings. Neutral bus shall be full size and of the same material as the phases buses. Neutral bus shall be 200% rated when supplied from a double neutral feeder. Provide copper equipment ground bus in each panelboard. In addition to the equipment ground bus, provide an isolated ground bus when supplied from a feeder which includes an isolated grounding conductor. Neutral and ground buses shall be capable of terminating one conductor per pole position minimum.

E. Main and Neutral Lugs: Mechanical type

F. Where a main breaker is indicated, it shall be factory mounted to the bus and shall be located in panel as indicated. Branch-mounted main breakers are prohibited.

G. Panelboards rated 240V ac or less shall have short-circuit ratings as shown on the drawings, but not less than 10,000 amperes RMS symmetrical.

H. Panelboards rated 480V ac shall have short-circuit ratings as shown on the drawings, but not less than 14,000 amperes RMS symmetrical.

I. Panelboards shall be labeled with a UL short-circuit rating. Provide "FULLY" rated panelboard unless noted otherwise. When series ratings are applied with integral or remote upstream devices, a label shall be provided. Series ratings shall cover all trip ratings of installed frames. It shall state the conditions of the UL series ratings, including:

1. Size and type of upstream device
2. Branch devices that can be used
3. UL series short-circuit rating

J. Molded-case as scheduled or required. Provide quick-make and quick-break toggle mechanism, inverse-time characteristics, and trip-free operation on overload or short-circuit. Automatic tripping shall be indicated by a handle position between the manual OFF and ON position. Provide a trip element for each pole, a common-trip bar for all poles and a single molded insulating material handle. Handle ties will not be accepted. Adjustable magnetic trip devices shall be set at the factory to the low trip setting unless otherwise noted. Provide breaker frame sizes as required to meet the continuous ampere rating and the interrupting capacity.

K. Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the overcurrent protective device ampere ratings indicated for future installation of devices.

L. Special Features: Include the following features for panelboards:

1. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
2. Door-in-Hinged Front Cover (Hinged Trim): Entire front trim hinged to box with standard hinged door with combined latch and lock within the hinged front. The cover shall have a continuous hinge on one side and machine screws into threaded holes in the panelboard cabinet on the other three sides. When open, the cover shall provide full access to the wiring gutters on three sides, and a minimum of 2-3/4-inch access on the hinge side without exposing live conductors.
3. Skirt for Surface-Mounted Panelboards: Where indicated on the plans provide same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and floor.

M. Feed-through Lugs: Sized to accommodate feeders indicated.

2.3 PANELBOARDS

A. Overcurrent Protective Devices: Fixed mains, bolt-on full-module circuit breakers.

1. Circuit Breakers for Equipment Marked Type HACR: Indicated as Type HACR.

B. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.4 DISTRIBUTION PANELBOARDS

A. Doors: In panelboard front, unless otherwise indicated. Secure door with vault-type latch with tumbler lock, all keyed alike.

B. Branch-Circuit Breakers: Where overcurrent protective devices are indicated to be circuit breakers, use bolt-on circuit breakers, except circuit breakers 225-A frame size and greater may be plug-in type where individual positive-locking device requires mechanical release for removal.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Molded-Case Circuit Breaker: NEMA AB 1, handle lockable.

1. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.
2. Application Listing: Appropriate for application, including Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.

4. Circuit Breakers, 400 A and Larger: Field-adjustable short-time and continuous current settings.
5. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
6. Shunt Trip: Where indicated.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: Arranged to permit testing of functions of solid-state trip devices without removal from panelboard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessory items according to NEMA PB 1.1.

B. Mounting Heights: Top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.

C. Mounting: Plumb and rigid without distortion of box. Mount flush panelboards uniformly flush with wall finish.

D. Circuit Directory: Type directory to indicate installed circuit loads after balancing panelboard loads. The directory shall clearly identify circuit numbers corresponding to the installed circuit breakers, and loads shall be identified by room number/area, type of load (i.e., printer, GFI receptacles, etc.), quantities, and other relevant information. Obtain approval before installing.

E. Install filler plates in unused spaces.

F. Install plugs on open knockouts.

G. Provision for Future Circuits at Flush Panelboards: Stub four 3/4-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

H. Wiring in Panelboard Gutters: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Panelboard Nameplates: Nameplates for identifying the panelboards shall be engraved laminated plastic strips black with white letters, attached by screws, or phenolic buttons or small window-frame

type. Adhesive stick-on labels alone will not be acceptable unless specifically approved. Panelboard nameplates shall include name of panel and voltage.

3.3 GROUNDING

A. Make equipment grounding connections for panelboards as indicated.

3.4 CONNECTIONS

A. 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.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Make insulation-resistance tests of each panelboard bus, component, and connecting supply, feeder, and control circuits.
2. Make continuity tests of each circuit.

B. Testing Agency: Provide services of a qualified independent testing agency to perform specified testing.

C. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

3.6 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.7 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

B. Backboxes shall be clean, dry and free of construction debris and fireproofing overspray prior to installation of panelboard interior.

C. Vacuum backboxes clean of debris after installation and wiring of branch circuits.

END OF SECTION 26 2416

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SECTION 26 2726 - SWITCHES AND RECEPTACLES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all switches, receptacles, and other devices as herein specified and shown on the associated drawings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Bryant, Arrow-Hart, Eagle, LaGrande, General Electric, Leviton, Hubbell are acceptable.

2.2 MATERIALS

A. The following list of wiring devices covers the most commonly specified items and establishes the grade of device. Should the Drawings indicate a device other than those listed herein without reference to catalog number, such device shall be of the same grade and manufacturer as like devices.

Single Pole Switches	Hubbell #1221
Duplex Receptacles - 20 amp	Hubbell #5362

All wiring devices and plates to be specification grade. Receptacles shall be mounted vertically with the ground pin down unless otherwise noted.

B. For normal power, provide white devices as per University standard. Provide stainless steel plates in ALL areas. Receptacles fed by UPS circuits shall have BLUE devices with "UPS POWER" engraved in white letters on a red nylon plate with panel and circuit designation engraved on plate.

C. Wet location and/or weatherproof receptacles shall be in a weatherproof enclosure, the integrity of which is not affected when the receptacle is in use (attachment plug cap inserted), UL labeled and listed “Suitable For Wet Locations While In Use”. Provide enclosure with stainless steel screws, gasket between enclosure and mounting surface and between cover and base, clear impact resistant UV stabilized polycarbonate as manufactured by TayMac Corporation or accepted equivalent.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide a separate GFI type receptacle for each receptacle noted on plans as GFI. Standard receptacles fed from an up-steam GFI type receptacle are not acceptable.

B. Install outlets and switches in a neat manner.

C. Faceplates, devices, and boxes shall be square with floor, and door lines.

D. Devices to be installed flush with faceplate.

3.2 LABELING

A. Provide self-adhesive labels for all switches and receptacles in compliance with Section 26 0500.

B. Where switches control remote lighting or power outlets, or where switches in the same outlet (two or more) serve different purposes, such as light, power, intercom, etc. or different areas, such as corridor and outside, provide self-adhesive labels clearly indicating the function of each switch or outlet.

END OF SECTION 26 2726

SECTION 26 2816 – 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 Division 01 Specifications, apply to this Section.

B. Refer to Division 26, Common Work Results for Electrical Systems.

1.2 REFERENCES

A. The latest edition of the following standards and codes, standard publications of professional organizations, and the local authorities having jurisdiction are the minimum requirements for this work.

1. American National Standards Institute (ANSI)
2. Institute of Electrical and Electronic Engineers (IEEE)
3. National Electrical Manufacturer's Association (NEMA)
4. National Fire Protection Association (NFPA)
5. NFPA 70, the National Electrical Code (NEC)
6. Underwriters Laboratories, Inc. (UL)
7. State, city, and local authorities

1.3 SUBMITTALS

A. General:

1. Submit each item in this Article according to the Conditions of the Contract and Division 01 Specifications.
2. All exceptions to this specification shall be given in written format referencing the section and paragraph and stating the proposed alternative to the requirement.
3. The information continued in the submittal shall be complete in every respect, as partial submittals shall be cause for rejection.

B. Product data for disconnect switches, circuit breakers, and accessories specified in this section as follows:

1. Descriptive data and ratings for voltage, continuous current, maximum horsepower, and short-circuit rating
2. Dimensional plans, elevations, sections, and details
3. NEMA enclosure type and size
4. Cable terminal size, number, and material
5. Unit wiring diagrams depicting local and remote devices

6. Accessories device descriptive bulletins and product data sheets (i.e., shunt trip coil, undervoltage release, ground fault, auxiliary contacts, key interlocks, etc.)

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70, the National Electrical Code.

C. All equipment and materials will be new and unused and shall conform with the current applicable industry standards. Workmanship and neat appearance shall be as important as electrical and mechanical operation. Defective or damaged materials shall be replaced or repaired prior to final acceptance in a manner meeting approval of Architect and/or Engineer and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Disconnect Switches and Circuit Breakers: Acceptable manufacturers are listed below. All disconnect and circuit breakers shall be of the same manufacturer.

   a. Eaton Corp.; Cutler-Hammer Products
   b. General Electric Co.; Electrical Distribution & Control Div.
   c. Square D Co.; Schneider Electric USA

2. Fuses: Acceptable manufacturers are listed below. All fuses shall be of the same manufacturer.

   a. Cooper Bussmann, Inc.
   b. Mersen USA, LLC
   c. Littelfuse, Inc.

2.2 DISCONNECT SWITCHES

A. Enclosed fusible and non-fusible switches, 1200-amp and smaller, NEMA KS1, heavy duty type with lockable handle, 600-volts, horsepower rated for motors as required. Number of poles and ampacity as noted or required by Code. Short-circuit rating shall be sufficient to withstand the available fault current or let-through current before the fuse melts without damage or change in rating.

B. Fusible switches 30- through 600-amperes shall be furnished with rejection class "R" or "J" type fuse clips and 800 through 1200 amperes shall be furnished with class "L" type fuse clips.

C. Switches shall incorporate a safety cover interlock to prevent opening the cover with the switch in the "ON" position or prevent placing the switch in the "ON" position with the cover open. Provide a “defeater” for authorized personnel.

D. Handles shall have provisions for padlocking and shall clearly indicate the ON and OFF positions. Front cover doors shall be padlockable in the closed position.

2.3 FUSES

A. Fuses shall be Class K-1 and K-5 of rejection type for 600 amperes and below and Class L for over 600 amperes. Fuse voltage class shall be either 250 volt or 600 volt and shall be applied according to circuit voltage.

B. Coordinate the low-voltage fuses required for the project to provide basic selective protection and properly coordinate with the other associated protective equipment.

2.4 CIRCUIT BREAKERS

A. General:

1. Provide 600-volt enclosed molded case circuit breaker per NEMA AB1 with lockable handle with frame size, trip rating, number of poles, and interrupting rating to meet available fault current. Application listing shall be appropriate for switching fluorescent lighting loads or heating, air conditioning, and refrigerating equipment.
2. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-breaker over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
3. Thermal-magnetic Circuit Breakers: Frame sizes 400 amp and smaller shall have 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 amp and larger.
4. Adjustable Instantaneous-trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

B. Circuit-breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style suitable for number, size, and material of conductors.
2. Application Listing: Appropriate for application; Type HACR for heating, air-conditioning, and refrigerating equipment.

2.5 ENCLOSURE

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices in general area of equipment and accessible to maintenance personnel according to manufacturer's written instructions. Secure devices firmly to supporting structure with approved fasteners in a level and plumb manner. Verify voltage and amperage size and enclosure type of devices for each installation. Where practical, devices shall be mounted such that the top of switch is a maximum of 6'-0" above finished floor or surface.

B. Connect devices to wiring system and to ground as indicated and instructed by manufacturer. 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.

C. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse. Install labels indicating fuse replacement information on inside door of each fused switch.

D. Identify each device according to requirements in other sections of these specifications.

3.2 OVERCURRENT PROTECTIVE DEVICES

A. Install fuses where required as a protective device in conformance with equipment manufacturer's specified requirements and in accordance with the requirements of this section.

3.3 EQUIPMENT CONNECTIONS

A. Provide all final power connections for mechanical equipment. All equipment items will be furnished and set by others. Confirm with suppliers all rough-in data, e.g., electrical characteristics, dimensions, locations, type of connection, etc., prior to installation.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
2. Test continuity of each line- and load-side circuit.

B. Testing Agency: Engage a qualified independent testing agency to perform specified testing.

C. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 ADJUSTING

A. Set field-adjustable switches and circuit breaker trip ranges.

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint and plaster splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 2816

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SECTION 28 3100 – FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Division 26, Common Work Results for Electrical Systems.

B. Refer to Division 26, Vibration and Seismic Requirements for Electrical Systems.

1.2 SUMMARY

A. Refer to Division 26, Common Work Results for Electrical Systems.

B. The work described in this specification consists of all labor, materials, equipment, and services necessary and required to design, install and test the automatic fire detection and alarm system to the satisfaction of the Authority Having Jurisdiction (AHJ). Any material not specifically mentioned in this specification or not shown on drawings, but required for proper performance and operation as specified, shall be furnished and installed. Device quantities and locations shown on the drawings are diagrammatic only.

C. The automatic fire detection and alarm system shall meet the requirements of the Owner.

D. Fire detection and alarm system design documents shall be sealed and signed by a Professional Engineer (P.E.), or by a NICET level 3 or 4 Technician and shall include the following:

1. selection of type of system and components
2. identification of fire alarm panel location
3. creation of system concept riser diagram(s)
4. identification of interface(s) required with fire safety functions, other fire alarm systems and other building systems
5. determine average ambient sound level
6. determine minimum candela ratings and placement of strobes
7. identification of all initiating device and notification appliance locations
8. shop drawing preparation, including:

    a. the layout, the circuiting and placement of initiating devices, notification appliances, and other system components
    b. preparation of riser diagram(s)
    c. inclusion of notification appliance circuit voltage drop calculations
    d. battery calculations for secondary power
    e. technical data sheets and details for the specific equipment being furnished for installation

1.3 REQUIREMENTS OF REGULATORY AGENCIES AND STANDARDS

A. This installation shall be made in accordance with the drawings, specifications, and the following:

1. National Electrical Code (NEC)
2. National Fire Alarm Code (NFPA 72)
3. International Building Code (IBC)
4. International Fire Code (IFC)
5. Americans with Disabilities Act (ADA)
6. Underwriters Laboratory (UL)
7. Local codes and Authorities Having Jurisdiction

1.4 SYSTEM DESCRIPTION

A. General: Non-coded, addressable-analog system with manual and automatic alarm initiation and multiplexed signal transmission dedicated to fire alarm service only. All automatic and manual initiating devices shall be the addressable type.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include annotated catalog data showing manufacturer's name, model, voltage, and catalog numbers for all equipment and components.

B. Shop Drawings:

1. Wiring Diagrams: Detail wiring and differentiate between manufacturer-installed and field-installed wiring. Include diagrams for equipment and for systems which are supervised or controlled by the FACP with all terminals and interconnections identified. Diagrams shall show all connections from field devices to the FACP and remote fire alarm control units, initiating circuits, switches, relays, and terminals. Provide point-to-point wiring diagrams showing all internal panel wiring connections and jumper positions.
2. Power Supply and Battery: Sizing calculations for both the alarm and supervisory power requirements. Ampere-hour requirements for each system component shall be submitted with the calculations.
3. Voltage drop calculations shall be included.
4. Provide data on each circuit to indicate that there is at least 25% spare capacity for notification appliances, 25% spare capacity for initiating devices.
5. Floor Plans: Indicate final quantities and device locations, equipment/enclosure locations, raceway routings,, junction boxes, and other system components required by the AHJ.
6. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations to the satisfaction of the AHJ for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
7. Provide a complete list of device addresses and corresponding messages.
8. Provide detailed drawings of the graphic annunciator construction and wiring connections.
9. Graphic Panel: Submit full-size drawing at actual production scale.
10. Provide electronic copy of shop drawings.

C. Submissions to Authorities Having Jurisdiction (AHJ):

1. In addition to distribution requirements for Submittals specified in Division 01 Section "Submittals," make an identical submission simultaneously to the AHJ. Provide the number of sets required for plan review by the AHJ. Include copies of annotated Contract Drawings as needed to depict component locations to facilitate review.
2. Resubmit if required to make clarifications or revisions to obtain approval.
3. Fire alarm shop drawings shall be sealed and signed by a Professional Engineer (P.E.), or by a NICET level 3 or 4 Technician; both shall be licensed in Utah. By signing and sealing the documents, the Professional Engineer (P.E.), or NICET level 3 or 4 Technician shall certify that the fire alarm installation meets requirements of the local codes and applicable sections of NFPA.
4. On receipt of comments from authorities having jurisdiction, submit these comments to Architect/Engineer for review.
5. Provide three copies of approved shop drawings, including all AHJ comments at conclusion of review period, to Architect/Engineer.

D. Coordination Drawings: Plans, sections, and elevations drawn to scale and coordinating installation of smoke detectors in ducts and access to them. Show the following near each duct smoke provision of detector installation:

1. Size and location of ducts, including lining
2. Size and location of piping
3. Size and arrangement of structural elements
4. Size and location of duct smoke detector, including air-sampling elements

E. Operating Instructions: Specific to the installed system. Provide for permanent mounting at the FACP.

F. Product Certificates: Signed by manufacturers of system components certifying that products furnished comply with applicable codes, standards, field conditions, and AHJ requirements.

G. Installer Certificates: Signed by system installer certifying that the system installation and tests comply with applicable codes, standards, field conditions, and AHJ requirements.

H. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Comply with NFPA 72 and the IFC. Include copy of all test reports with the final Operation & Maintenance manual.

I. Maintenance Data: Data for fire alarm systems to be included in maintenance manuals specified in Division 01. Comply with NFPA 72 and the IFC.

J. Certificate of Completion: Comply with NFPA 72 and the IFC.

1.6 QUALITY ASSURANCE

A. Engineer Qualifications: A Professional Engineer (P.E.), licensed in Utah, with a minimum of 5 years fire alarm design and installation experience who is an authorized representative of the FACP manufacturer for both design and installation of components required for this Project.

B. NICET Technician Qualifications: A NICET professional, level 3 or 4, with a minimum of 5 years fire alarm design and installation experience who is an authorized representative of the FACP manufacturer for both design and installation of components required for this Project.

C. Installer Qualifications: An experienced installer with a minimum of 5 years of fire alarm installation experience, who is an authorized representative of the FACP manufacturer for both installation and maintenance of units required for this Project.

D. Manufacturer Qualifications: A firm with a minimum of five years of experience in manufacturing systems similar to those indicated for this Project and with a record of successful in-service performance.

E. Source Limitations: Obtain fire alarm system components through one source from a single manufacturer.

F. Compliance with Local Requirements: Comply with applicable building codes, local ordinances and regulations, and requirements of the AHJ.

G. Coordinate the distributor location and response time in paragraph below with Owner's requirements.

H. The manufacturer's authorized distributor shall confirm that they have an established agency that stocks a full complement of replacement parts and offers service during normal working hours on all equipment to be furnished within 50 miles of the job site. Maximum response time for initial service shall be 24 hours from initial contact.

I. The manufacturer's authorized distributor shall confirm that the agency will supply parts within 24 hours and at reasonable cost.

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. Lamps for Strobe Units: Quantity equal to 5% of amount installed, but not less than one unit.
2. Detectors: Quantity equal to 5% of amount of each type installed, but not less than one unit of each type.
3. Detector Bases: Quantity equal to 2% of amount of each type installed, but not less than one unit of each type.
4. Audible alarm devices. Quantity equal to 5% of amount of each type installed, but not less than one unit of each type.
5. Visible alarm devices. Quantity equal to 5% of amount of each type installed, but not less than one unit of each type.
6. Audible/visible alarm devices. Quantity equal to 5% of amount of each type installed, but not less than one unit of each type.
7. Printer Ribbons: Six spares.
8. Keys and Tools: One extra set for access to locked and tamper-proofed components.
9. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by the following:

1. Gamewell-FCI, a part of the Honeywell Life Safety Group

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Control of System: By the FACP.

B. System Supervision: Automatically detect and report open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.

C. Priority of Signals: Automatic alarm response functions resulting from an alarm signal from one zone or device are not altered by subsequent alarm, supervisory, or trouble signals. An alarm signal is the highest priority. Supervisory and trouble signals have second- and third-level priority. Higher-priority signals take precedence over signals of lower priority, even when the lower-priority condition occurs first. Annunciate and display all alarm, supervisory, and trouble signals regardless of priority or order received.

D. Noninterference: A signal on one zone shall not prevent the receipt of signals from other zones.

E. System Reset: All zones are manually resettable from the FACP after initiating devices are restored to normal.

F. Transmission to Remote Alarm Receiving Station: Automatically route alarm, supervisory, and trouble signals to a remote alarm station by means of a digital alarm communicator transmitter and telephone lines.

G. System Alarm Capability during Circuit Fault Conditions: System wiring and circuit arrangement prevent alarm capability reduction when a single ground occurs in an initiating device circuit, signal line circuit, or notification-appliance circuit. Refer to Paragraph 2.20 for wiring Class.

H. Loss of primary power at the FACP initiates a trouble signal at the FACP. The FACP indicates when the fire alarm system is operating on the secondary power supply.

I. Basic Alarm Performance Requirements: Unless otherwise indicated, operation of a manual station, automatic alarm operation of a smoke or flame or heat detector, or operation of a sprinkler flow device initiates the following:

1. Notification-appliance operation.
2. Identification at the FACP and the remote annunciator of the zone originating the alarm.
3. Identification at the FACP and the remote annunciator of the device originating the alarm.
4. Transmission of an alarm signal to the remote alarm receiving station.
5. Unlocking of electric door locks in designated egress paths.
6. Release of fire and smoke doors held open by magnetic door holders.
7. Recall of elevators.

8. Shutdown of fans and other air handling equipment associated with the device where alarm was initiated.
9. Closing of smoke dampers in air ducts of the system associated with the device where the alarm was initiated.
10. Recording of the event in the system memory.
11. Recording of the event by the system printer.

J. Alarm Silencing, System Reset, and Indication: Controlled by switches in the FACP and the remote annunciator.

1. Silencing-switch operation halts both audible and visual notification appliances and activates an "alarm silence" light. Display of identity of the alarm device is retained.
2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

K. Water-flow alarm switch operation initiates the following:

1. Notification-appliance operation.
2. Flashing of the device location-indicating light for the device that has operated.
3. Activation of the horn/strobe at the Fire Department Connection.

L. Smoke detection initiates the following:

1. Audible and visible indication of an "alarm verification" signal at the FACP.
2. Activation of a listed and approved "alarm verification" sequence at the FACP and the detector.
3. Recording of the event by the system printer.
4. General alarm if the alarm is verified.
5. Cancellation of the FACP indication and system reset if the alarm is not verified.

M. Sprinkler valve-tamper switch operation initiates the following:

1. A supervisory, audible, and visible "valve-tamper" signal indication at the FACP and the annunciator.
2. Flashing of the device location-indicating light for the device that has operated.
3. Recording of the event by the system printer.
4. Transmission of supervisory signal to remote alarm receiving station.

N. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system initiates the following:

1. A supervisory, audible, and visible "sprinkler trouble" signal indication at the FACP and the annunciator.
2. Flashing of the device location-indicating light for the device that has operated.
3. Recording of the event by the system printer.
4. Transmission of trouble signal to remote central station.

O. Remote Detector Sensitivity Adjustment: Manipulation of controls at the FACP causes the selection of specific addressable smoke detectors for adjustment, display of their current status and sensitivity settings, and control of changes in those settings. Same controls can be used to program repetitive,

scheduled, automated changes in sensitivity of specific detectors. Sensitivity adjustments and sensitivity-adjustment schedule changes are recorded in system memory and are printed out by the system printer.

P. Removal of an alarm-initiating device or a notification appliance initiates the following:

1. A "trouble" signal indication at the FACP and the annunciator for the device or zone involved
2. Recording of the event by the system printer
3. Transmission of trouble signal to remote alarm receiving station

Q. Logging and Printout of Events: On receipt of the signal, log 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 log system reset event, including the same information for device, location, date, and time. Commands initiate the printout of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

R. FACP 80-Character LCD Alphanumeric Display: Plain-English-language descriptions of alarm, supervisory, and trouble events; and addresses and locations of alarm-initiating or supervisory devices originating the report. Display monitoring actions, system and component status, system commands, programming information, and data from the system's historical memory.

2.3 MANUAL PULL STATIONS

A. Description: General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Fabricated of metal or plastic, and finished in red with molded, raised-letter operating instructions of contrasting color, shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism initiates an alarm.
2. Station Reset: Key or wrench operated; double pole, double throw; switch rated for the voltage and current at which it operates.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false alarm operation.
4. Include subparagraph below if weatherproof protective shield without horn is required.
5. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.
6. Integral Addressable Module: Arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.

2.4 SMOKE DETECTORS

A. A. General: Include the following features:

1. Operating Voltage: 24V dc, nominal.
2. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

3. Plug-in Arrangement: Detector and associated electronic components are mounted in a module that connects in a tamper-resistant manner to a fixed base with a twist-locking plug connection. Terminals in the fixed base accept building wiring.
4. Integral Visual-Indicating Light: LED type. Indicates detector has operated.
5. Sensitivity: Can be tested and adjusted in-place after installation.
6. Integral Addressable Module (base-mounted): Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
7. Remote Controllability: Unless otherwise indicated, detectors are analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

B. Photoelectric Smoke Detectors: Include the following features:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector Sensitivity: Between 2.5 and 3.5% per foot (0.008 and 0.011% per mm) smoke obscuration when tested according to UL 268A.
3. Integral Thermal Detector: Fixed-temperature type with 135°F (57°C) setting.

C. Ionization Detector: Include the following features:

1. Responsive to both visible and invisible products of combustion.
2. Self-compensating for changes in environmental conditions.

D. Beam-Type Smoke Detector: Each detector consists of a separate transmitter and receiver with the following features:

1. Adjustable Sensitivity: More than a six-level range, minimum.
2. Linear Range of Coverage: 600 feet (180 m), minimum.
3. Tamper Switch: Initiates trouble signal at the central FACP when either transmitter or receiver is disturbed.
4. Separate Color-Coded LEDs: Indicate normal, alarm, and trouble status. Any detector trouble, including power loss, is reported to the central FACP as a composite "trouble" signal.

2.5 OTHER DETECTORS

A. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135°F (57°C) or rate of rise of temperature that exceeds 15°F (8.3°C) per minute, unless otherwise indicated.

1. Mounting: Plug-in base, interchangeable with smoke detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

B. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190°F (88°C).

1. Mounting: Plug-in base, interchangeable with smoke detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

C. Continuous Linear Heat-Detector System: Consists of detector cable and control unit.

1. Detector Cable: Comply with UL 521. Rated detection temperature 155°F (68°C). Listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short circuit wires at the location of elevated temperature.
2. Control Panel: Two-zone or multizone unit as indicated. Provides same system power supply, supervision, and alarm features as specified for the central FACP.
3. Signals to the Central FACP: Any type of local system trouble is reported to the central FACP as a composite "trouble" signal. Alarms on each detection zone are individually reported to the central FACP as separately identified zones.
4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.6 NOTIFICATION APPLIANCES

A. Description: Equip for mounting as indicated and have screw terminals for system connections.
1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly. Alarm silence feature shall halt both audible and visual notification appliances.

B. Bells: Electric-vibrating, 24V dc, under-dome type; with provision for housing the operating mechanism behind the bell. When operating, bells provide a sound-pressure level of 94 dB, measured 10 feet (3 m) from the bell. 10-inch (254-mm) size, unless otherwise indicated. Bells are weatherproof where indicated.

C. Horns: Electric-vibrating-polarized type, 24V dc; with provision for housing the operating mechanism behind a grille. Horns produce a sound-pressure level of 90 dB, measured 10 feet (3 m) from the horn. Horn shall have minimum alarm level of 15 dB above the average ambient noise level in all occupied spaces.

1. Separate horn silence feature.

D. Visible Alarm Devices: Xenon strobe lights listed under UL 1971 with clear or nominal white polycarbonate lens and ADA compliant. Mount lens on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high (25-mm) letters on the lens.

1. Rated Light Output:

a. a 110 cd.
b. 15/30/75/110 cd, selectable in the field.

2. Strobe Leads: Factory connected to screw terminals.
3. Mounting: Wall mounted unless otherwise indicated.
4. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
5. Flashing shall be in a temporal pattern, synchronized with other units.
6. Mounting Faceplate: Factory finished, red.

E. Voice/Tone Notification Appliances (Refer to Paragraph 2.10.H):

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: Flush, semirecessed, surface, or surface-mounted; bidirectional as indicated.
5. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.

F. Exterior horn/strobes shall provide 110 candela, with a xenon strobe, clear lens, and the word “FIRE” marked in red on the lens and a horn type sounder providing 87 dba at a distance of 10 feet. The exterior horn/strobe shall be located above the automatic sprinkler system Siamese connection, or as shown on the drawings. Back-box and horn/strobe shall be UL listed for exterior use in wet locations.

2.7 FIREFIGHTERS' TELEPHONES

A. Comply with NFPA 72 requirements for two-way telephone communication service. Dedicated, two-way, supervised, telephone voice communication links between fire-alarm control unit, the fire command center, and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. Provide the following:

1. Telephone Master Handset: High-impact plastic handset, heavy-duty coil cord, and hook switch; mounted integral to the FACP. Handset has a dynamic receiver and a carbon transmitter, operating on 24V dc.
2. Telephone Remote Handsets: High-impact plastic handset, heavy-duty coil cord, and hook switch; connected to the FACP by dedicated phone jack and supervised communication lines. Handsets have a dynamic receiver and a carbon transmitter, operating on 24V dc.
3. Coordinate paragraph and subparagraphs below with Drawings.
4. Handset Cabinet: Flush or surface mounted as indicated, stainless steel with a latched hinged door with red trim.

    a. Exterior Identification: "Firefighters' Handsets"
    b. Size: To accommodate handset and cords (minimum of six)

5. Remote Cabinet: Flush or surface mounted as indicated, stainless steel with a latched hinged door with red trim, with handset.

    a. Exterior Identification: "Firefighters' Telephone"
    b. Interior Identification: Station number and location
    c. Size: To accommodate handset and cord

6. Remote Jack: Flush-mounted, 1-gang stainless steel plate with integral fire fighter’s phone jack and red plastic trim.

    a. Identification: "Firefighters' Phone Jack" with engraved station number and location

2.8 REMOTE DEVICE LOCATION-INDICATING LIGHTS AND IDENTIFICATION PLATES

A. Description: LED indicating light near each smoke detector that may not be readily visible, and each sprinkler water-flow switch and valve-tamper switch. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

B. Provide a remote indicator light above the doorway leading into each room with an automatic initiating device.

2.9 CENTRAL FACP

A. Cabinet: Lockable steel enclosure. Arrange interior components so operations required for testing or for normal maintenance of the system are performed from the front of the enclosure. If more than one unit is required to form a complete control panel, fabricate with matching modular unit enclosure to accommodate components and to allow ample gutter space for field wiring and interconnecting panels.

1. Identify each enclosure with an engraved, red, laminated, phenolic-resin nameplate with lettering not less than 1 inch (25 mm) high. Identify individual components and modules within cabinets with permanent labels.
2. Mounting: Flush.

B. Alarm and Supervisory Systems: Separate and independent in the FACP. Alarm-initiating zone boards consist of plug-in cards. Construction requiring removal of field wiring for module replacement is unacceptable.

C. Control Modules & Signal Boosters: Include types and capacities required to perform all functions of fire alarm systems.

D. Indications: Local, visible, and audible signals announce alarm, supervisory, and trouble conditions. Each type of audible alarm has a different sound.

E. Indicating Lights and System Controls: Individual LED devices identify zones transmitting signals. Zone lights distinguish between alarm and trouble signals, and indicate the type of device originating the signal. Manual switches and push-to-test buttons do not require a key to operate. Controls include the following:

1. Alarm acknowledge switch.
2. Alarm silence switch.
3. System reset switch.
4. LED test switch.
5. Horn silence switch.

F. Resetting Controls: Prevent the resetting of alarm, supervisory, or trouble signals while the alarm or trouble condition still exists.

G. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components, including annunciation, supervision, and control. Accessible without opening the panel front.

1. Display: A minimum of 80 characters; alarm, supervisory, and component status messages; and indicate control commands to be entered into the system for control of smoke detector sensitivity and other parameters. Back-lit display on failure of normal power source.
2. Keypad: Arranged to permit entry and execution of programming (password-protected), display, and control commands.

H. Occupant Notification: An emergency communication system, includes central voice notification system components complete with microphones, preamplifiers, amplifiers, and tone generators. Features include the following:

1. Two alarm channels permit simultaneous transmission of different announcements to different zones or floors automatically or by using the central control microphone. All announcements are made over dedicated, supervised communication lines.
2. Status annunciator indicates the status of various voice alarm speaker zones and the status of firefighters' two-way telephone communication zones.
3. Digital Voice Message Recorder: With tone signal generation capabilities. Tone signal followed by digitally recorded voice message. Minimum of two selectable, pre-recorded voice messages stored in non-volatile memory. Manual announcement feature with selectable override of manual feature or pre-recorded messaging.

I. Firefighters' Telephone Control Module: Controls firefighters' two-way telephone communication system. Arrange system to use dedicated, two-way, supervised voice communication links between the FACP and remote firefighters' telephone stations throughout the building. Supervised telephone lines shall be connected to talk circuits by controls in this module. Controls provide the ability to disconnect phones from talk circuits if too many phones are in use simultaneously. Include local Occupant Notification defeat feature when handset is lifted or phone is plugged into jack. The module includes the following:

1. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is activated, it causes the audible signal to sound and the high-intensity lamp to flash.
2. Selector panel controls simultaneous operation of telephones in selected zones and permits up to six phones to be operated simultaneously. Ground faults and open or shorted telephone lines are indicated on the panel front by individual LEDs. Zone-selector switches with associated LED indicators permit the firefighter to activate selected telephone zones. LED indicators display elevator recall status.

J. Instructions: Printed 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.

2.10 REMOTE ANNUNCIATOR

A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, reset, and test.

1. Mounting: Surface cabinet, NEMA 250, Class 1

B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

C. Graphic Display Panel for Remote Annunciator: Wall-mounted engraved panel indicating the building floor plan with a "You Are Here" designation. Painted metal frame with hinged glass front.

1. Materials: White plastic (minimum 1/8-inch thick) with black ink silk screen.
2. Floor Plan Scale: 3/32 inch = 1'-0" unless otherwise noted.
3. Mounting: Adjacent to remote annunciator.
4. Floor plan oriented with north to top, unless directed otherwise by local requirements.

2.11 EMERGENCY POWER SUPPLY

A. General: Components include nickel-cadmium battery, charger, and an automatic transfer switch.

1. Battery Nominal Life Expectancy: 20 years, minimum.

B. Battery Capacity: Comply with NFPA 72.

1. Design capacity for 24-hour quiescent load conditions, plus 5-minute alarm at the end of the 24-hour period, with 10% spare capacity.
2. Magnetic door holders are not served by emergency power. Magnetic door holders are released when normal power fails.

C. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150% of the connected system load while maintaining batteries at full charge. If batteries are fully discharged, the charger recharges them completely within four hours. Charger output is supervised as part of system power supply supervision.

D. Integral Automatic Transfer Switch: Transfers the load to the battery without loss of signals or status indications when normal power fails.

2.12 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module listed for use in providing a multiplex system address for listed fire and sprinkler alarm-initiating devices with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to initiate a control device such as the elevator controller to initiate elevator recall or to a circuit-breaker shunt trip for power shutdown.

2.13 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Listed and labeled under UL 864 and NFPA 72.

B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP panel, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising two lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.

C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.

D. Self Test: Conducted automatically every 24 hours with report transmitted to central station.

2.14 SYSTEM PRINTER

A. Description: Listed and labeled as an integral part of the fire alarm system.

2.15 GUARDS FOR PHYSICAL PROTECTION

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory-fabricated and furnished by the manufacturer of the device
2. Finish: Paint of color to match the protected device
3. UL Listed for application with the intended device

2.16 WIRE

A. Non-Power-Limited Circuits: Solid-copper conductors with 600V rated, 75°C, color-coded insulation. Comply with NEC Article 760 (II).

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.

B. Power-Limited Circuits: NFPA 70, solid-copper conductors, Types FPL, FPLR, or FPLP, as recommended by manufacturer. Comply with NEC Article 760 (III).

C. Where required by NFPA 72, provide 2 hour-rated cable for notification appliances.

2.17 CIRCUITS

A. Network Communications: NFPA 72, Class B, Level 1

B. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B ; Level 1.

1. Initiating Device Circuits: single open (trouble indication); single ground (trouble indication, alarm receipt during abnormal condition).
2. Notification Appliance Circuits: single open (trouble indication); single ground (trouble indication, alarm receipt during abnormal condition); wire-to-wire short (trouble indication)..
3. Install no more than 100 addressable devices on each signaling line circuit.

C. Serial Interfaces:

1. Two RS-232 ports for printers and terminals
2. One dedicated RS 485 port for remote station operation using point ID DACT.
3. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
4. One USB port for PC configuration.
5. One RS 232 port for VESDA HLI connection.
6. One RS 232 port for voice evacuation interface.

2.18 EMERGENCY RESPONDER RADIO

A. Comply with the IFC and local jurisdictional authorities for installation of the emergency responder radio. Provide a site survey testing the RF signals at and within the facility; comply with the requirements of the local emergency responder radio requirements. Provide site-approved radio coverage for emergency responders within the building based on the existing coverage levels of the public safety communication systems of the jurisdiction at the exterior of the building.

B. Radio signal strength in 95% of all areas on each floor of the building:

1. Minimum signal strength into the building. Provide minimum receivable signal strength of -95 dBm within the building.
2. Minimum signal strength out of the building. Provide minimum transmitted signal strength received by the local agency's radio system of -100 dBm when transmitted from within the building.

C. Radio Enhancement System: Provide a bidirectional amplifier (BDA) system or a distributed antenna system (DAS) acceptable to the local agency including power supplies, antennas, and signal boosters.

D. Provide all essential components shall be installed in a room accessible for repair and testing within the structure that is rated at 2-hours.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

1. Connect the FACP to a circuit breaker with lockable handle or cover.

B. Manual Pull Stations: Mount semiflush in recessed back boxes. Mounting height shall comply with ADA requirements.

C. Water-Flow Detectors and Valve Supervisory Switches: Connect for each sprinkler valve station required to be supervised.

D. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (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 in NFPA 72.
5. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

E. Wall-Mounted Smoke Detectors: At least 4 inches (100 mm), but not more than 12 inches (300 mm), below the ceiling.

F. Smoke Detectors near air-supply diffuser or return-air opening: Install no closer than 5 feet (1.5 m).

G. Duct Smoke Detectors: Comply with manufacturer's written instructions.

1. Comply with NFPA 72 and NFPA 90A.
2. Verify that each unit is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
3. Install sampling tubes so they extend the full width of the duct.

H. Heat Detectors in Elevator Shafts and Equipment Rooms: Coordinate temperature rating and location with sprinkler rating and location.

I. Audible Alarm-Indicating Devices: The locations of the notification appliance devices where shown on the drawings are a recommendation only. Additional devices may be required to comply with the audibility requirements of NFPA 72. Install with bottom of device backbox at 80 inches AFF, but not less than 6 inches (150 mm) below the finished ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Combine audible and visible alarms at the same location into a single unit.

J. Visible Alarm-Indicating Devices: Install in combination with each alarm bell or alarm horn with additional units as required for NFPA 72 and ADA minimum location, spacing, and candela requirements. Install bottom of device backbox at 80 inches AFF, but not less than 6 inches (150 mm) below the finished ceiling. Where more than two strobes are visible from a single location provide strobe synchronization.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

L. Equipment Mounting: Semi-flush mount fire-alarm control panel with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

M. Annunciator: Install with the top of the panel not more than 72 inches (1830 mm) above the finished floor.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with NEC Article 760. Unless otherwise indicated, install wiring in metal raceway according to Division 26 Section "Raceways and Boxes for Electrical Systems." Conceal raceway except in unfinished spaces and as indicated. Class A circuits shall be installed such that the outgoing and return conductors are routed separately from the FACP in accordance with NFPA 72, Part 6.4.

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.

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. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing control monitoring equipment as necessary to extend existing control monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Electrical Identification."

B. Install operating instructions at a location that is readable from the FACP.

C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.4 GROUNDING

A. Ground cable shields and equipment according to system manufacturer's written instructions to eliminate shock hazard and to minimize, to the greatest extent possible, ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding.

C. Install grounding electrodes of type, size, location, and quantity as indicated. Comply with installation requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Ground equipment and conductor and cable shields. For audio circuits, minimize, to the greatest extent possible, ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

E. Ground radio alarm transmitter system and equipment as recommended by the manufacturer.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and connections and to supervise pretesting, testing, and adjustment of the system. Report results in writing.

B. Pretesting: After installation, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the compliance of the system with requirements of Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones, and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

C. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of witnesses to preliminary tests.

D. Final Test Notice: Provide a minimum of 10 days' notice in writing when the system is ready for final acceptance testing.

E. Minimum System Tests: Test the system according to procedures outlined in NFPA 72. Minimum required tests are as follows:

1. Verify the absence of unwanted voltages between circuit conductors and ground.
2. Test all conductors for short circuits using an insulation-testing device.
3. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on record drawings.
4. Verify that the control unit is in the normal condition as detailed in the manufacturer's operation and maintenance manual.
5. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10% of initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
6. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
7. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications. Observe all voice audio for routing, clarity, quality, freedom from noise and distortion, and proper volume level.
8. Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the period and in the manner specified.

F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets Specifications and complies with applicable standards.

G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log on the satisfactory completion of tests.

H. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

3.6 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, adjusting, and maintaining equipment and schedules. Provide a minimum of 8 hours of training.
2. Training Aid: Use the approved final version of the operation and maintenance manual as a training aid.
3. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

3.8 ON-SITE ASSISTANCE

A. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions. Provide up to three requested visits to Project site for this purpose.

END OF SECTION 28 3100

SECTION 31 05 13

COMMON FILL

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Common fill material.

1.2 **REFERENCES**

A. **ASTM Standards**:

C136 Sieve Analysis of Fine and Coarse Aggregates.

D448 Classification for Sizes of Aggregate for Road and Bridge Construction.

D1883 CBR (California Bearing Ratio) of Laboratory-Compacted Soils.

D2487 Classification of Soils for Engineering Purposes.

D2844 Resistance R-Value and Expansion Pressure of Compacted Soils.

D3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

D3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

F1647 Organic Matter Content of Putting Green and Sports Turf Root Zone Mixes.

1.3 **SUBMITTALS**

A. **General**. If a change in source of material is required, submit name of Supplier, source and gradation analysis of material before delivery to site.

B. **Topsoil**. Submit certification from topsoil Supplier assuring topsoil product meets requirements in this Section.

C. **Borrow, granular borrow, granular backfill borrow, recycled fill, sand, gravel.** Before delivering material to site, identify:

1. Name of Supplier and source.
2. Gradation, classification and CBR.
3. Percent composition of reclaimed bituminous concrete or Portland cement concrete included in the mix.

D. **Slag, pumice, scoria**. Identify name of supplier, source, and density.

1.4 **QUALITY ASSURANCE**

A. Use a laboratory that complies with ASTM D3740 and Section 01 45 00 requirements.

B. Reject fill products that do not meet requirements of this section.

C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

1.5 **ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot. One (1) lot is one (1) day productional
2. Dispute resolution, Section 01 35 10.

B. **Roadway Backfill**: Sub-lot size is 5,000 tons.

PART 2 PRODUCTS

2.1 **BORROW**

A. Classifications A-1-a through A-4, ASTM D3282.

2.2 **GRANULAR BORROW**

A. Classifications A-1-a, A-1-b, A-2-4, or A-3, ASTM D3282.

B. Material meets design CBR-value (ASTM D1883) or R value (ASTM D2844) for suitability of source, not for project control testing.

2.3 **GRANULAR BACKFILL BORROW**

A. Classification A-1, ASTM D3282.

B. Well graded.

C. Particle size, two (2) inch maximum.

D. Material meets design CBR-value (ASTM D1883) or R value (ASTM D2844) for suitability of source, not for project control testing.

2.4 **RECYCLED FILL**

A. Material: Pulverized Portland cement concrete, pulverized bituminous concrete pavement or combination, either mixed with or not mixed with a new aggregate.

B. Gradation: Meet requirements of this section based upon use; e.g. borrow, granular borrow, granular backfill borrow, etc.

2.5 **NATIVE**

A. When allowed by ENGINEER, material obtained from Excavations may be used as fill, provided organic material, rubbish, debris, and other objectionable materials are removed, and CONTRACTOR has submitted the appropriate proctor density data (see Section 31 23 26).

2.6 **CLAY**

A. Classification CL, CL-ML, or ML, ASTM D2487.

B. Free of organic matter, frozen material, debris, rocks, and deleterious materials.

C. Homogeneous, relatively uniform.

2.7 **SAND**

A. Friable river or bank aggregate, free of loam and organic matter. Graded as follows.

2.8 **GRAVEL**

Sieve	**Percent Passing by Weight**
3/8	100
100	1 – 10

A. Material: Rock, stone, or other high quality mineral particle or combination.

Sewer Rock.

Pea Gravel.

Nominal Size	Size No. 3.5 to 1.5”	ASTM 1
2.5 to 1.5”	2	
2 to 1”	3	
1.5 to 3/4”	4	
1 to 1/2"	5	

Nominal Size	Size No. 3/4 to 3/8”	ASTM 6
1/2 to No. 4	7	
3/8 to No. 8	8	

2.9 **TOPSOIL**

No. 4 to No. 16	9
No. 4 (screenings)	10

A. Chemical Characteristics:

1. Acidity and alkalinity range: pH 5.5 to 7.7
2. Soluble Salts: Less than 2.0 mmhos/cm.
3. Sodium Absorption Ratio (SAR): less than 3.0
4. Nitrogen (NO_3N): 48 ppm minimum
5. Phosphorus (P): 11 ppm minimum
6. Potash (K): 130 ppm minimum
7. Iron (Fe): 5.0 ppm minimum

B. Physical Characteristics:

1. Fertile, loose, friable.
2. Free of weeds, subsoil, lumps or clods of hard earth, plants or their roots, sticks, toxic minerals, chemicals and stones greater than 1-1/2 inch diameter.
3. Composition, ASTM D2487:

Material	**Percent**
Sand	15 – 60
Silt	10 – 70
Clay	5 – 30
Organic matter	2 - 5

Humus determined by ASTM F1647. Peat may be used as an organic amendment to meet the humus requirements.

2.10 **SLAG, PUMICE, SCORIA**

A. Chemically inert, porous, durable, free draining.

Table 1 – Gradation and Density				
Criteria		**Slag**	**Pumice**	**Scoria**
Gradation, US Sieve	3”	100	100	100
	1 1/2"	80 – 100	80 – 100	80 – 100
	3/4"	20 – 100	--	--
	3/8”	0 – 20	0 – 20	40 – 100
	No. 4	0 – 10	0 – 10	10 – 70
	No. 16	--	0 – 65	0 – 40
	No. 50	--	0 – 40	0 – 25
	No. 200	0 – 3	0 – 3	0 – 15
Density, pound per cubic foot		85 – 100	75 – 80	60 – 75
NOTES: (a) Gradations are based upon percent of material passing sieve by weight, ASTM C136. (b) Density measured as in-place target.				

2.11 **SOURCE QUALITY CONTROL**

A. Verify gradation, ASTM C136.

B. Select samples on a random location and time basis.

C. If tests indicate materials do not meet specified requirements, change materials and retest at no additional cost to OWNER.

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 31 11 00

SITE CLEARING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Removal of trees, stumps, roots, and tree debris.

B. Clearing site of plant life, root systems and shrubs.

C. Removal of fences, fence posts, mail box posts, and miscellany.

1.2 **REFERENCES**

A. **NAA Standards**:

Pruning Standards for Shade Trees.

B. **Utah Shade Tree Pruning Standards**.

1.3 **QUALITY ASSURANCE**

A. Provide at least one person, who is familiar with NAA pruning standards for the type of tree involved, to be present during tree pruning operations.

1.4 **SITE CONDITIONS**

A. Repair or replace damaged trees and shrubs at no additional cost to OWNER.

1.5 **PROTECTION**

A. Protect roots and branches of trees to remain.

B. Construct temporary barricading at tree's approximated drip line. Place continuous barricades at least three (3) feet high.

C. When setting posts, avoid damaging tree roots.

D. Do not permit heavy equipment or stockpiling of materials or debris within the barricaded area, or permit earth surface to be changed.

E. Provide water and fertilizer to maintain existing trees.

PART 2 PRODUCTS

2.1 **STUMP TREATMENT SOLUTION**

A. Formulated to kill existing vegetation.

PART 3 EXECUTION

3.1 **EXAMINATION**

A. The drawings do not purport to show all trees and shrubs existing on site.

B. Verify with ENGINEER which plantings are to be removed or to remain.

C. Tree root inspection:

1. Assist ENGINEER by removing and replacing existing surface improvements.

2. Cost of removals and replacements will be paid for using existing payment prices, or if none, then by using contract Modification prices.

3.2 **PREPARATION**

A. Locate utilities. Preserve utilities that are to remain in service, Section 31 23 16.

B. Review work procedures with ENGINEER.

C. Schedule work carefully with consideration for property owners and general public.

D. Before starting, arrange for disconnection of all utility services that are to be removed or which interfere with work.

3.3 **SITE CLEARING**

A. Remove all vegetation outside of excavation, fill slope lines, and limits of slope rounding.

B. Remove fences, posts, appurtenances, and miscellaneous objects.

3.4 **TREE REMOVAL**

A. Remove branches, limbs, and debris.

B. Remove stumps and roots to 18 inches below proposed grade.

C. For stumps larger than six (6) inches caliper remove and treat as follows:

1. Remove chips and debris from around remaining stump.
2. Apply stump treatment solution in accordance with manufacturer's recommendations.
3. Do not allow chemical solution to mist, drip, drift, or splash onto adjacent ground surfaces or desirable vegetation.
4. Replace any existing vegetation damaged or killed through improper use of chemical at no additional cost to OWNER.

END OF SECTION

SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavation and disposal of excavated materials.

B. Protection of existing facilities such as utilities, vegetation, structures affected by excavation, etc.

1.2 PAYMENT PROCEDURES

A. No Contract Time extension shall be granted, and no additional compensation shall be made if buried utilities or structures that conflict with the Work have not been found by Keyholing.

B. Perform Incidental Excavation at no additional cost to OWNER.

1.3 DEFINITIONS

A. **Authorized Over Excavation**: Upper limit of excavation is proposed excavation limit. Lower and lateral limits are as authorized by ENGINEER.

B. **Classified Excavation**: The excavation of specified materials.

C. **Incidental Excavation**: Excavation done for CONTRACTOR's benefit, excavation error, dewatering of excavation, slough, or over-break.

D. **Unclassified Excavation**: The excavation of all materials encountered regardless of the nature, size, or manner in which they are removed. Presence of isolated boulders or rock fragments will not be sufficient cause to change classification of surrounding materials.

E. **Keyholing**: The process of making a small, precisely controlled hole for “day-lighting”, or uncovering and exposing underground utilities, in order to locate or inspect them.

1.4 STORAGE AND HANDLING

A. Stockpile excavated material to cause minimum inconvenience to public and provide for emergency services as necessary.

B. Provide free access to existing fire hydrants, water valves, gas valves, and meters.

C. Provide free flow of storm water in all gutters, conduits, and natural water courses.

D. Utilize traffic control signs, markers, and procedures in product storage and handling activities.

E. Promptly remove other material from site.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

A. Common fill, Section 31 05 13.

B. Aggregate base course, Section 32 11 23.

C. Stabilization fill, aggregate base course or common fill with maximum rectilinear particle size of two (2) inches.

D. Stabilization fabric, Section 31 05 19.

PART 3 EXECUTION

3.1 PREPARATION

A. Photograph existing surfaces where work will take place to document conditions before excavation, Section 01 78 39.

B. Use white paint and mark the proposed excavation.

C. Call the one-call center and wait the required amount of time. Colors of one call center marks indicate the following:

White	Proposed excavation
Red	Electric power lines, cables, conduit and lighting cables
Yellow	Gas, oil, steam, petroleum or gaseous materials.
Orange	Communications, alarm, signal, cables or conduits.
Blue	Potable water.
Purple	Reclaimed water, irrigation and slurry lines.
Green	Sewer and storm drain lines.
Pink	Temporary survey markings.

D. Implement traffic control plan requirements, Section 01 55 26.

E. For temporary controls, refer to Section 01 57 00.

3.2 PROTECTION

A. Identify required lines, grades, contours, and benchmarks, Section 01 71 23.

B. Utilities:

1. Keyhole, expose or otherwise locate utilities as necessary to give utility agency at least one (1) day notice to protect, preserve, or relocate a utility that may interfere with or may be damaged by excavation work. Preserve utilities that remain in service.
2. Where utilities or structures conflict with design grades, report conflict to appropriate utility company and ENGINEER 14 days before initiating work within the conflict area.

C. Support and protect from damage any existing facility and structure that

exists in, passes through, or passes under the site.

D. Protect existing landscape sprinkler systems. When sprinkler system disturbance is required, interrupt and repair system so operation of system is maintained, Section 02 41 13.

E. Carefully remove soil around tree roots so ENGINEER can assess stability and health of tree.

3.3 GENERAL EXCAVATION REQUIREMENTS

A. Excavate topsoil from areas to be relandscaped or regraded and other marked areas.

B. Excavate site to line and grade indicated. Legally dispose of excavated material.

C. Carefully excavate soils in vicinity of buried utility marks placed by the one-call center.

D. Where soil has been softened or eroded by flooding or hardened by drying, rework all damaged areas or replace with approved material at no additional cost to OWNER.

E. Notify ENGINEER of unexpected subsurface conditions.

F. Underpin adjacent structure, service utilities and pipe chases that may be damaged by excavation work.

G. Protect excavation walls as required. If conditions permit, slope excavation sides to maintain a safe and clean working area. Remove loose materials.

H. Where ENGINEER deems subgrade material to be susceptible to frost heave or otherwise unsatisfactory, excavate additional depth.

3.4 **TOPSOIL**

A. Excavate topsoil only to depth that will preserve topsoil quality.

B. Do not mix topsoil with subsoil during stockpiling or spreading.

3.5 **SHORING**

A. Slope, shore, sheet, brace or otherwise support excavations over four (4) feet deep, Section 31 41 00.

B. When soil conditions are unstable, excavations shallower than four (4) feet deep must also be sloped, supported or shored.

3.6 **DEWATERING**

A. Keep excavation free from surface and ground water.

B. If ground water is in the intended construction operations, dewater excavations.

C. If there are no olfactory or visual indications of contamination in the water, discharge according to requirements of Federal, State or local agency having jurisdiction.

D. If any evidence of contamination in the water, based on olfactory or visual indications, cease excavation work until potential risks are evaluated. During evaluation, handle water as a contaminated material.

E. Pay for damages and costs resulting from dewatering operations.

3.7 **ROADWAY EXCAVATION**

A. In advance of setting line and grade stakes, clear and grub area of brush, weeds, vegetation, grass, and debris. Drain all depressions or ruts.

B. Roadway excavation is Unclassified Excavation. It includes Portland cement concrete or bituminous concrete pavement removal and removal of any aggregate base or sub-base material to line and grade established by Drawings or ENGINEER.

3.8 **STRUCTURAL AND LANDSCAPE EXCAVATION**

A. Provide shoring, cribs, cofferdams, caissons, pumping, bailing, draining, sheathing, bracing, and related items.

B. For piling work, coordinate special requirements for piling. Protect excavation walls.

C. If conditions permit, slope excavation sides as excavation progress. Maintain a safe and clean working area.

D. Support excavations. Do not interfere with the bearing of adjacent foundations, pipelines, etc.

3.9 **TRENCH EXCAVATION**

A. Grade bottom of trenches to provide uniform bearing surface.

B. If necessary, make bell holes and depressions required for laying and joining pipe or box.

C. Limit width of trench excavations to the dimensions suitable for worker access per pipe manufacturer's recommendation. Provide enough space for compaction equipment. Notify ENGINEER if excavation operations exceed any indicated line and grade limits.

D. In roadways and regardless of trench depth, limit length of open trenches to 200 lineal feet day or night. Provide barricading, Section 01 55 26. Protect trenches over night.

3.10 **STABILIZATION EXCAVATION**

A. Perform stabilization excavation as Incidental Excavation.

3.11 **AUTHORIZED OVER EXCAVATION**

A. Over excavation must be permitted by ENGINEER to be classified as authorized over excavation. Volume will be determined by the method of average-end-areas in the original position.

3.12 **TOLERANCE**

A. Grading: Top surface of Subgrade = plus or minus 1 inch.

END OF SECTION

SECTION 31 23 23

BACKFILLING FOR STRUCTURES

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Structural backfill materials.

B. Structural backfilling requirements.

1.2 **REFERENCES**

A. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft- lbf/ft^3 (2,700 kN-m/m^3)).

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 **SUBMITTALS**

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material, and
2. Each type of fill to be used.

1.4 **QUALITY ASSURANCE**

A. Do not change material sources or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements specified in this Section.

C. If requested, submit a written quality control inspections and testing report describing source and field quality control activities performed by CONTRACTOR and Suppliers.

1.5 **STORAGE**

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

1.6 **SITE CONDITIONS**

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural section to required density.

1.7 **ACCEPTANCE**

A. **General**: Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. **Material**: For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Aggregate base course, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

C. **Lift thickness**: One test per Lot.

D. **Compaction**: One test per Lot. Verify compaction using nuclear tests, ASTM D2922. Density and lot sizes as follows:

Table 1 – Density and Lot Sizes

Structure Type	Density	Proctor	Lot Size
Strip Footings	95	Standard	Subgrade: 200 linear feet
	98	Modified	Aggregate base course: 200 linear feet per lift.
Structure Footing excluding strip footings	95	Standard	Subgrade: 225 square feet.
	98	Modified	Aggregate base course: Each 225 square feet per lift
Embankments	95	Standard	Fill: 625 square feet per lift
Interior Slab on Grade	98	Modified	Aggregate base course: 625 square feet
Side of Foundation Walls and Retaining Walls	95	Standard	Exterior:
	98	Modified	Interior
Miscellaneous small structures (e.g. Manholes, drainage boxes, etc.)	95	Standard	Subgrade: Each footprint area Fill: Each lift
	98	Modified	Aggregate base course: Each lift

NOTES
(a) Standard proctor, ASTM D698.
(b) Modified proctor, ASTM D1557.

E. **Flowable Fill Strength**: Lot size is one day production with sub-lots of 250 cubic yards or part thereof. Verify strength using cylinders, ASTM D4832.

F. **Grade, Cross Slope**: Measured at random locations.

1.8 **WARRANTY**

A. Repair settlement damage at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13. Granular material, CONTRACTOR's choice.

B. Aggregate base course, Section 32 11 23. Untreated base course.

C. Cement treated fill, Section 31 05 15. Use a flowable fill so vibration is not required.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Verify:

1. Backfill material meets gradation requirements.
2. Foundation walls are braced to support surcharge forces imposed by backfilling operations, areas to be backfilled are free of debris, snow, ice or water.
3. Ground surface is not frozen.

C If ground water is in the intended backfill zone, dewater.

3.2 **PROTECTION**

A. Protect existing trees, shrubs, lawns, structures, fences, roads, sidewalks, pavings, curb and gutter and other features.

B. Protect above or below grade utilities. Contact utility companies to repair utility damage. Pay all cost of repairs.

C. Avoid displacement of and damage to existing installations while compacting or operating equipment. Do not fill adjacent to structures until excavation is checked by ENGINEER.

D. Do not use compaction equipment adjacent to walls or retaining walls that may cause wall to become over-stressed or moved from alignment.

E. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in trenches. Movement of construction machinery over work at any stage of construction is solely at CONTRACTOR's risk.

F. Restore any damaged structure to its original strength and condition.

3.3 **LAYOUT**

A. Identify required line, levels, contours, and datum.

B. Stake and flag locations of underground utilities.

C. Upon discovery of unknown utility or concealed conditions, notify ENGINEER.

D. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.

E. If discrepancy is found between Contract Documents and site, ENGINEER shall make such minor adjustments in the Work as necessary to accomplish the intent of Contract Documents without increasing the Cost of the Work to CONTRACTOR or OWNER.

3.4 **SUBGRADE**

A. Protect Subgrade from desiccation, flooding, and freezing.

B. Before backfilling over Subgrade, get ENGINEER's inspection of subgrade surface preparations.

C. If Subgrade is not readily compactable get ENGINEER's permission to stabilize the subgrade.

3.5 **FOUNDATIONS AND SLABS ON GRADE**

A. Lift thickness before compaction is eight (8) inches.

B. Do not backfill against walls until concrete has obtained 14 days strength. Backfill against foundation walls simultaneously on each side.

C. Fill unauthorized excavations with material acceptable to ENGINEER at no additional cost to OWNER.

D. Do not damage adjacent structures or service lines.

E. Where flowable fill is used, use fill that flows easily and vibration for compaction is not required.

3.6 **MODIFIED BACKFILL LAYER METHOD**

A. Section 33 05 20.

3.7 **TOLERANCES**

A. Compaction: Ninety-five (95) percent or ninety-eight (98) percent minimum relative to a standard or modified proctor density, Section 31 23 26.

B. Lift Thickness (before compaction):

1. Eight (8) inches when using riding compaction equipment.
2. Six (6) inches when using hand held compaction equipment.
3. As proven in the modified backfill layer method, Section 33 05 20.

C. Cement Treated Fill: Compressive strength targets are 60 psi in 28 days and 90 psi maximum in 28 days.

3.8 **CLEANING**

A. Remove stockpiles from site. Grade site surface to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 31 23 26
COMPACTION

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Compaction of granular fill materials.

1.2 REFERENCES
A. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft- lbf/ft^3 (2,700 kN-m/m^3))

D2216 Laboratory Determination of Water (Moisture) Content of Soil and Rock.

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

D3740 Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

1.3 DEFINITIONS
A. **A-1 Soil**: Defined in ASTM D3282.

B. **Modified Proctor Density**: The maximum laboratory density, as defined in and determined by ASTM D1557 using procedure A, B or C as applicable.

C. **Relative Density (or Relative Compaction):** The ratio of field dry density to the maximum laboratory density expressed as a percentage.

D. **Standard Proctor Density**: The maximum laboratory density, as defined in and determined by ASTM D698 using procedure A, B or C as applicable.

1.4 QUALITY ASSURANCE
A. Use a soil and rock laboratory that complies with ASTM D3740.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 COMPACTION
A. Moisten or dewater backfill material to obtain optimum moisture for compaction.

B. When no density compactive effort is specified, compact the entire area to 95 percent and eliminate unstable zones.

C. Correct deficient compaction conditions. Replace or repair materials and damaged facilities.

3.2 **FIELD QUALITY CONTROL**

A. **Testing**: Perform control testing of materials. Perform additional testing at no additional cost to OWNER, for

1. Changes in source of materials or proportions requested by CONTRACTOR, or
2. Failure of materials to meet specification requirements, or
3. Other testing services needed or required by CONTRACTOR.

B. **Optimum Soil Density**: Use ASTM D2216 and the following industry standards.

1. For A-1 Soils: Method C of ASTM D1557 (Modified Proctor)
2. For All Other Soils: Method C of ASTM D698 (Standard Proctor).

C. **Field Density**:

1. Use ASTM D3017 and test method C of ASTM D2922 for shallow depth nuclear testing.
2. No density determinations are required on any material containing more than 65 percent material retained on the number 10 sieve or more than 60 percent material retained on the number 4 sieve. In lieu of reporting densities in such cases, report the sieve analysis to document the material type.

3.3 **REPORT**

A. For each material tested, document the following:

1. Vertical and horizontal location of the test.
2. Optimum laboratory moisture content.
3. Field moisture content.
4. Maximum laboratory dry density.
5. Field density.
6. Percent compaction results.
7. Certification of test results by Independent Testing Agency.

END OF SECTION

SECTION 31 41 00
SHORING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Shoring for open Excavations requiring a Protective System.

B. Underpinning to stabilize adjacent structure.

1.2 **PRICE - MEASUREMENT AND PAYMENT**

A. **In Trenching Shoring**:

1. A two (2) Protective System is required if each Side of the Trench is to be shored. The use of a Trench Box shall be classified as one Protective System.
2. Payment covers cost of Protective System to a depth of three (3) feet below Excavation elevations indicated. Allowance for extra cost may be made, based upon the actual cost to CONTRACTOR of constructing, extending, or reconstructing any Protective System that may be necessary to carry excavation to required depth that is greater than three (3) feet below Excavation elevations indicated. Extra cost will be paid for by **Change Order**.

B. **Excavation in Lieu of Protective System**: If a Protective Systems is specified but the CONTRACTOR uses open excavation (without a protective system) and ENGINEER has knowledge of the alternate excavation operation, the CONTRACTOR will be paid in full for the Protective System specified, which includes extra excavation, extra backfill, backfill compaction, or other incidental work performed by CONTRACTOR in lieu of constructing the Shoring or underpinning.

1.3 **DEFINITIONS**

A. **Accepted Engineering Practices**: Those requirements or practices that are compatible with standards required by a duly licensed or recognized authority.

B. **Benching**: A method of protecting persons and property against cave-ins by excavating the Sides of an Excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

C. **Excavation**: Any man-made cut, cavity, or depression in an earth surface, including Trenches, formed by earth removal and producing unsupported earth conditions (Sides). If installed forms or similar structures reduce the depth-to-width relationship, an excavation may become a Trench.

D. **Failure**: The permanent deformation or breakage of a structural member or connection; or the collapse of all or part of an Excavation.

E. **Protective System**: Any recognized method of protecting persons and property against cave-ins, collapse of adjacent structures, or material that may fall or roll from an Excavation Side into an Excavation. Protective systems include Support Systems, Sloping and Benching systems and Shield systems.

F. **Shield**: A structure that is able to withstand the forces imposed on it by a cave-in and thereby protect persons and property within the structure without preventing a cave-in. Shields may be permanent structures or may be designed to be portable and moved along as work progresses. Portable Shields used in Trenches are usually referred to as "trench boxes" or "trench shields".

G. **Shoring**: A structure that supports the Sides of an Excavation and thereby protects persons and property from cave-ins.

H. **Side**: Vertical or inclined earth surface formed at the outer edges of an Excavation.

I. **Sloping**: A method of protecting persons and property against cave-ins by excavating to form

Sides that are inclined away from the Excavation, the angle of incline being of such a degree for the conditions of exposure that a cave-in will not occur.

J. **Support System**: A structure that protects persons and property by providing support to an adjacent structure, underground installation, or the Sides of an Excavation.

K. **Trench**: A narrow Excavation made in the surface of the ground. In general, the depth is greater than the width, but the width of a trench is not greater than 15 feet.

L. **Trench Box**: See Shield.

M. **Unfractured Rock**: Rock that can be excavated with vertical Sides and remain intact while exposed. Fractured rock is considered equivalent to unfractured rock when the material on the Side or Sides of the Excavation is secured against cave-in or movement by rock bolts, netting, or other means approved by a licensed design professional.

1.4 **DESIGN OF PROTECTIVE SYSTEMS**

A. Design Support Systems, Shield systems, structural components of these systems, and Sloping and Benching systems to resist all loads that are intended to be imposed or transmitted to them.

B. Design a system for any hydrostatic pressure in the Sides of an Excavation.

1.5 **SUBMITTALS**

A. Submit a Protective System plan when requested.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. CONTRACTOR's choice.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Make safe or remove trees, surface encumbrances that are hazardous to Shoring operations.

B. Provide adequate ventilation of Excavations.

C. Control dust and groundwater.

3.2 **STABILITY OF ADJACENT STRUCTURES**

A. Support adjoining buildings, walls, sidewalks, pavements, or other structures endangered by excavation operations.

B. Excavation below level of base of footing of any structural foundation or wall shall not be permitted except as follows:

1. Underpinning or other Support Systems is provided to ensure stability of structure, or
2. Excavation is in Unfractured Rock, or
3. A licensed design professional determines in writing that such work will in no way pose a hazard to persons and property or the integrity of the structure.

3.3 **PROTECTION OF PERSONS AND PROPERTY**

A. Protect from cave-ins. Install a Support System, by Sloping, by Benching, by use of a Shield system, or by use of a combination of these methods.

B. Scale to remove loose material. Use rock bolting, wire mesh, installation of protective barricades, or provide equivalent protection.

C. Stairway, Ladder, Ramp: Comply with OSHA.

D. Protect against cave-ins from vibratory loads adjacent to excavation operations.

3.4 **INSPECTIONS**

A. Inspect Excavations daily for evidence of possible cave-ins, indications of Failure of Protective Systems, or other hazardous conditions.

B. Upon discovery of hazardous conditions, cease all work in Excavations until additional precautions have been taken to ensure persons and property safety.

3.5 **SHIELD SYSTEMS**

A. Minimize time when Sides of an Excavation remain unsupported.

B. Do not subject Shield systems to loads other than those considered in their design.

C. Remove persons and property from Excavation when portable Shields are being relocated.

3.6 **INSTALLATION AND REMOVAL OF SUPPORT SYSTEMS**

A. Do not overload Support Systems.

B. Install additional members to carry loads imposed upon the Support System when temporary removal of individual members is necessary.

C. When removing Support System, release member by member slowly to avoid Failure of the remaining members or cave-ins.

D. Coordinate backfilling to minimize time an unsupported Excavation remains open.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Treated and untreated base course production and placement.

1.2 **REFERENCES**

A. **AASHTO Standards**:

R9 Acceptance Sampling Plans for Highway Construction.

B. **ASTM Standards**:

C29 Unit Weight and Voids in Aggregate.

C131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C117 Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing.

C136 Sieve Analysis of Fine and Coarse Aggregates. D75 Sampling Aggregates.

D448 Sizes of Aggregate for Road and Bridge Construction.

D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D1883 CBR (California Bearing Ratio) of Laboratory-Compacted Soils.

D2216 Laboratory Determinations of Water (Moisture) Content of Soil and Rock.

D2419 Sand Equivalent Value of Soils and Fine Aggregate. D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D3665 Random Sampling of Construction Materials. D3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils. D5821 Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.

1.3 **DEFINITIONS**

A. **Master Grading Band**: A graphical area defined by gradation limits allowed for various sieve sizes ranging from the maximum sieve size to the No. 200 sieve.

B. **Target Grading Curve**: A smooth locus of points within the limits of the Master Grading Band.

C. **Target Grading Band**: Gradation limits defined by the allowable variance from the Target Grading Curve. It is possible that these limits may lie outside of the Master Grading Band.

D. **Mean of Deviations**: The sum of the absolute values of the variance between each screen target value and each measured value divided by the number of tests in the Lot.

E. **RAP**: Acronym for reclaimed asphalt pavement. See Section 32 12 16.18.

F. **Lot**: (a) Quantity of aggregate delivered to a site when considering gradation, (b) area of aggregate placed at a site when considering density.

1.4 **SUBMITTALS**

A. **Mix Design**: Provide the following. Allow ENGINEER 10 days to evaluate the submittal.

1. Date of mix design. If older than 365 days from date of submission, recertify mix design.
2. Name of supplier and aggregate source.
3. Target gradation for each sieve size,
4. Percent composition of reclaimed asphalt or concrete included in the mix.
5. Unit weight, CBR, relative density, and relative moisture content.
6. Aggregate physical properties (this section article 2.1). The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed. Test results shall not be older than 455 days from date of submission.

B. **At Delivery**: Submit batch delivery ticket identifying serial number of ticket, date and truck number, job name, weight of aggregate, mix identification, and description.

1.5 **QUALITY ASSURANCE**

A. Do not change aggregate source until ENGINEER accepts new source and new mix design.

B. Use a laboratory that follows and complies with ASTM D3740 and Section 01 45 00 requirements.

C. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.6 **ACCEPTANCE**

A. **General:**

1. Acceptance is by Lot.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring complying material as part of its installation, Section 01 29 00.
3. ENGINEER is not obligated to accept changes in gradation target after any material is delivered to site.
4. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.
5. Dispute resolution, Section 01 35 10.

B. **Gradation**: Lot size is one (1) day production. Sub-lot size is 500 tons. Collect samples from grade before compaction. Conduct at least one (1) gradation analysis for each lot. Lot is acceptable if gradation test deviations are within pay factor 1.00 limits. At ENGINEER's discretion, a lot with a sub-lot deviation greater than pay factor 0.70 limits may stay in place at 50 percent pay.

Table 1- Gradation Pay Factors

Criteria	Pay Factor	Mean of Deviations of Acceptance Tests From the Target Grading Curve Expressed in Percentage Points				
		1 Sample	2 Samples	3 Sample	4 Sample	5 or More Samples
1/2" and Larger Sieves	1.00	0 – 15	0.0 – 12.1	0.0 – 10.8	0.0 – 10.0	0.0 – 9.5
	0.95	16 – 17	12.2 – 13.9	10.9 – 12.4	10.1 – 11.5	9.6 – 11.
	0.90	18 – 19	14.0 – 15.1	12.5 – 13.5	11.6 – 12.5	11.1 – 11.9
	0.80	20 – 21	15.2 – 17.2	13.6 – 15.3	12.6 – 14.2	12. – 13.5
	0.70	22 – 23	17.3 – 18.8	15.4 – 16.7	14.3 – 15.5	13.6 – 14.7
3/8" Sieve	1.00	0 – 15	0.0 – 11.5	0.0 – 9.8	0.0 – 8.8	0.0 – 8.0
	0.95	16 – 17	11.6 – 13.2	9.9 – 11.3	8.9 – 10.1	8.1 – 9.2
	0.90	18 – 19	13.3 – 14.4	11.4 – 12.3	10.2 – 11	9.3 – 10.0
	0.80	20 – 21	14.5 – 16.3	12.4 – 13.9	11.1 – 12.5	10.1 – 22.4
	0.70	22 – 23	16.4 – 17.9	14.0 – 15.2	12.6 – 13.6	11.5 – 12.4

No. 4 Sieve	1.00	0 – 14	0.0 – 10.5	0.0 – 8.8	0.0 – 7.8	0.0 – 7.0
	0.95	15 – 17	10.6 – 12.1	8.9 – 10.1	7.9 – 9.0	7.1 – 8.0
	0.90	18	12.2 – 13.1	10.2 – 11	9.1 – 9.8	8.1 – 8.7
	0.80	19 – 20	13.2 – 14.9	11.1 – 12.5	9.9 – 11.1	8.8 – 10.0
	0.70	21 – 22	15.0 – 16.3	12.6 – 13.6	11.2 – 12.1	10.1 – 10.8
No. 16 Sieve	1.00	0 – 11	0.0 – 8.2	0.0 – 6.9	0.0 – 6.2	0.0 – 5.6
	0.95	12 – 13	8.3 – 9.4	7.0 – 7.9	6.3 – 7.1	5.7 – 6.4
	0.90	14	9.5 – 10.3	8.0 – 8.6	7.2 – 7.8	6.5 – 7.0
	0.80	15 – 16	10.4 – 11.6	8.7 – 9.8	7.9 – 8.8	7.1 – 8.0
	0.70	17	11.7 – 12.7	9.9 - 10.7	8.9 – 9.6	8.1 – 8.7

No. 200 Sieve	1.00	0 – 4.5	0.0 – 3.4	0.0 – 2.9	0.0 – 2.5	0.0 – 2.3
	0.95	4.6 – 5.2	3.5 – 3.9	3.0 – 3.3	2.6 – 2.9	2.4 – 2.6
	0.90	5.3 – 5.6	4.0 – 4.3	3.4 – 3.6	3.0 – 3.1	2.7 – 2.9
	0.80	5.7 – 6.4	4.4 – 4.9	3.7 – 4.1	3.2 – 3.6	3.0 – 3.3
	0.70	6.5 – 7.0	4.9 – 5.3	4.2 – 4.5	3.7 – 3.9	3.5 – 3.6

NOTES
(a) ENGINEER has 36 hours after Lot placement to accept aggregate gradation. CONTRACTOR may place material over the crushed aggregate base material during the 36 hours interval at its own risk. Pay factors for the Lot will NOT be applicable if ENGINEER performs tests after the 36 hours interval.

C. **Relative Density**: Lot size 10,000 cubic yards. Conduct at least one laboratory determination to be used as a standard for field density and field moisture content determinations.

D. **Field Density**: Lot size is one (1) day placement. Number of density tests varies according to placement type, location and sub-lot size (Table 2). Conduct at least one (1) field density test in the lot. Select each test location randomly.

Table 2 - Placement Type, Location, Sub-lot Size

Type	Location	Sub-lot Size
I	Pavement (includes curb, gutter and water way when in conjunction with pavement placement).	1,000 square yards
II	Curb, gutter, waterway	200 linear feet
	Sidewalk	400 linear feet
	Driveway approach, curb cut assembly, waterway transition structure, flat work	400 square feet
III	Landscaping and other non-structural, non- load bearing areas	--

PART 2 PRODUCTS

2.1 UNTREATED BASE COURSE

A. **Material**: Crushed rock, gravel, sand, or other high quality mineral particle, or combination that is free of organic matter, free of chemical or petroleum contamination, and meets the following physical properties.

Table 3 – Untreated Base Course Physical Properties

	ASTMs	Aggregate Class		
		A	B	C
Coarse aggregate				
Angularity (2 fractured faces), min., percent	D5821	50	–	–
Wear (toughness or hardness), max., percent	C131	50		
Fine aggregate				
Liquid Limit, max.	D4318	25		
Plastic Index, max.	D4318	0	0	6
Sand Equivalent, min., percent	D24 19	35		
Blended aggregate				
Dry Rodded Unit Weight, min., percent	C29	75		
CBR, min., percent	D1883	70	55	--

NOTES
(a) Faces: Retained on No. 4 sieve.
(b) Wear: Retained on No. 12 sieve after 500 revolutions.
(c) Liquid limit and plastic index: Passing No. 40 sieve.
(d) Sand equivalent (clay content or cleanliness): Passing No. 4 sieve.
(e) CBR: Use a surcharge of 10 pounds measured at 0.20 inch penetration at 95 percent relative to a modified proctor density. A reduction in aggregate class may be accepted providing any costs for difference in excavation, backfill, and alternate design for CBR does not increase Concrete Price.

B. **Gradation**: Analyzed according to ASTM C136 on a dry weight and percent passing basis. Target Grading Curve must lie within the selected aggregate grade in table 4. Field gradation shall not vary from target by more than the target tolerance.

Table 4 – Master Grading Bands

Sieve	Aggregate Grade			Target Tolerance
	Grade 1-1/2	Grade 1	Grade 3/4	
1-1/2"	100	–	–	(Pay factor 1.00 in Table 1)
1 "	–	100	–	
3/4 "	70 – 85	–	100	
1/2 "	–	79 – 91	–	
3/8 "	55 – 75	–	78 – 92	
No. 4	40 – 65	49 – 61	55 – 67	
No. 16	25 – 40	27 – 35	28 – 38	
No. 200	7 – 11	7 – 11	7 – 11	

NOTES
(a) It is assumed fine and course aggregate have same bulk specific gravity.
(b) Target tolerance for 3/4 sieve in Grade 3/4, and 1" sieve in Grade 1 is not applicable.
(c) Percentage of fines passing No. 200 sieve determined by washing, ASTM C117.

C. **Changing Source**: A new material properties report is required.

2.2 **TREATED BASE COURSE**

A. Treatment includes addition of lime, cement slurry, asphalt emulsion, RAP, crushed concrete, or any combination, or other material acceptable to ENGINEER.

B. Base course containing RAP:

1. Meet requirements of this section article 2.1 and the following:
   a. Sand equivalent and fractured face measured after asphalt residue is burned off.
   b. Plasticity and wear requirements apply to virgin aggregate portion only.
   c. Allowable asphalt content is controlled by allowable CBR.
2. Remove debris from crushed RAP aggregate by screening.
3. Mechanically blend virgin and RAP aggregates. Do not use windrows for blending.

C. Base course containing crushed concrete.

1. Meet requirements of this section article 2.1 and the following:
   a. Cement with its chemical components is allowed.
   b. Wear test and fractured face test not required.

2.3 **SOURCE QUALITY CONTROL**

A. Reject crushed aggregate base products that do not meet requirements of this Section.

B. Sampling Protocol: Random location selection, ASTM D3665. Sample collection, ASTM D75.

C. Testing Protocol: Gradation, ASTM C136. Maximum density, ASTM D1557. Optimum moisture content, ASTM D2216.

PART 3 EXECUTION

3.1 **SUB-BASE PREPARATION**

A. Trenches, Section 33 05 20.

B. Structures, Section 31 23 23.

C. Landscaping, Section 32 91 19.

D. Pavements, Section 32 05 10.

3.2 **PLACEMENT**

A. General:

1. Place uniform lifts not exceeding eight (8) inches before compaction.
2. Maintain optimum moisture content plus or minus two (2) percent.
3. Use appropriate compaction equipment.
4. Do not place additional material on any unaccepted layer or on any frozen surface.

B. Provide aggregate suitable for the following locations.

Table 5 - Placement Type, Location, Aggregate Class

Type	Location	Aggregate Class		
		A	B	C
I	Pavement (includes curb, gutter and waterway when in conjunction with pavement placement)	X		

II	Concrete flat work (includes driveway approach, curb cut assembly, curb, gutter, sidewalk, waterway, etc.	**X**	**X**	
III	Landscape (includes non-structural, non-load bearing areas.	**X**	**X**	**X**
NOTES: (a) **X** indicates where placement is allowed.				

C. Compaction:

1. Type I and Type II Placement: 95 percent minimum.
2. Type III Placement: Suitable to overlying surface, or installation, or use. Verify compactive effort with ENGINEER.

D. Finish: Uniform with surface deviation no more than 3/8 of an inch from line and grade in 10 feet in any direction.

3.3 FIELD QUALITY CONTROL

A. Sampling Protocol: Random location selection, ASTM D3665. Sample collection, ASTM D75.

B. Testing Protocol: Gradation, ASTM C136. Field density, ASTM D2922. Moisture content, ASTM D3017.

3.4 REPAIR OR REMOVAL

A. If product is correctable and at no additional cost to OWNER, provide laboratory data showing design CBR has not been reduced and material in-place has been compacted to 97 percent minimum.

B. Remove any product that cannot be corrected and install acceptable product at no additional cost to OWNER.

END OF SECTION

SECTION 33 05 07
POLYVINYL CHLORIDE PIPE

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Polyvinyl chloride pipe, couplings, fittings and joint materials.

1.2 **REFERENCES**

A. **ASTM Standards**:

D1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

D2241 Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR - Series).

D2321 Underground Installation of Flexible Thermoplastic Sewer Pipe.

D2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

D2564 Solvent Cement for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

D2729 Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D2774 Underground Installation of Thermoplastic Pressure Piping. D2855 Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

D3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

F656 Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

F679 Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

F949 Poly(vinyl Chloride) (PVC) Corrugated sewer Pipe with a Smooth Interior and Fittings.

B. **AWWA Standards**:

C110 Ductile-Iron and Gray-Iron Fitting, 3 inches Through 48 inches, for Water and Other Liquids.

C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution.

C905 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In.

C909 Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in. Through 24 In., for Water, Wastewater, and Reclaimed Water Service.

1.3 **DEFINITIONS**

A. **Standard Dimension Ratio (SDR):** Outside diameter of pipe divided by wall thickness.

1.4 **QUALITY ASSURANCE**

A. Evaluate pipes that show damage such as dents, cuts, cracks, breaks, fractures, or distortions. Recommend appropriate action. ENGINEER may require CONTRACTOR provide certification by a professional engineer competent in the structural design of the pipe material for action recommended.

PART 2 PRODUCTS

2.1 PRESSURE PIPE SYSTEM

A. Pipe: AWWA C900, C905, or C909 as applicable. Use outside diameters defined by ductile iron pipe sizes. Dimensions, class, SDR, and tolerances per ASTM D2241.

B. Compounds: Type 1, Grade 1, Class 12454A, ASTM D1784.

C. Joints:

1. Bell and spigot with flexible elastomeric seals, ASTM D3139. Use non-toxic lubricant.
2. Solvent weld, ASTM D2564.

D. Fittings (4 inch and larger): Ductile iron Class 250, ASTM C110.

2.2 GRAVITY PIPE SYSTEM

A. Pipe:

1. Solid smooth wall:
   a. 4 to 15 inch diameter, ASTM D3034.
   b. 18 to 27 inch diameter, ASTM F679.
2. Corrugated wall with a smooth interior, 4 to 10 inches diameter, ASTM F949.

B. Fittings: ASTM D1784.

C. Stiffness: 50 psi minimum when measured at five (5) percent deflection, ASTM D2412.

D. Additives and Fillers: Not to exceed 10 parts by weight; 100 parts of resin in the compound.

E. Joints: Bell and spigot with flexible elastomeric seals, ASTM D3212.

F. Flattening: No visual evidence of splitting, cracking, or breaking when 730

flattened to 60 percent deflection, ASTM D2412.

2.3 PERFORATED PIPE SYSTEM

A. Pipe: Refer to gravity pipe products above.

B. Perforations: ASTM D2729.

C. Joints: Push-on, solvent weld or other.

2.4 SOLVENT WELDS

A. Primer, ASTM F656.

B. Glue, ASTM D2564.

PART 3 EXECUTION

3.1 INSTALLATION

A. Assembly: Abide by manufacturer's instructions and the following. Use the more stringent provisions if there are any conflicts.

1. Pressurized Systems:
   a. Water distribution and transmission, Section 33 11 00, AWWA C900, C905, and C909.
   b. Underground irrigation, Section 32 84 23, and ASTM D2855.
2. Gravity Systems:

a. Sanitary sewers, Section 33 31 00.
b. Under drains and storm drains, Section 33 41 00.

B. Burial: Comply with Section 33 05 20 and the following. Use the more stringent provisions if there are any conflicts.
1. ASTM D2774 for pressure pipe systems.
2. ASTM D2321 for gravity pipe systems.

END OF SECTION

SECTION 33 05 20

BACKFILLING TRENCHES

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Backfill materials in trenches and backfilling requirements.

1.2 **REFERENCES**

A. **APWA (Utah) Standards**: Plan 381 Trench backfill

Plan 382 Pipe zone backfill

B. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 **DEFINITIONS**

A. **Bedding**: That surface of the excavation or portion of the Pipe Zone below the pipe.

B. **Pipe Zone**: That zone in a backfilling operation which supports, and surrounds the pipe barrel, and extends to 1 foot above the top of the pipe barrel.

1.4 **SUBMITTALS**

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material, and
2. Each type of fill to be used.

B. Submit aggregate batch delivery tickets showing name of material source, serial number of ticket, date and truck number, name of Supplier, job name and location, volume or weight. And aggregate classification or Supplier's identification code.

1.5 **QUALITY ASSURANCE**

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements in this Section.

C. If requested, submit a quality control inspections and testing report describing source and field quality control activities performed by CONTRACTOR and Suppliers.

1.6 **STORAGE**

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

1.7 **SITE CONDITIONS**

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and

rutted areas.

C. Reshape and compact damaged structural section to required density.

D. Restore any damaged structure to its original strength and condition.

E. Replace contaminated backfill at no additional cost to OWNER.

1.8 **SEQUENCING**

A. Coordinate backfilling operation with pipeline commissioning, Section 33 08 00.

1.9 **ACCEPTANCE**

A. General: Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. Material: For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Aggregate base course, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

C. Lift Thickness: One test per lot.

D. Compaction: One test per lot. Verify density using nuclear tests, ASTM D2922. Compaction standard and Lot sizes as follows:

Table 1: Compaction Standard and Lot Size

Material	Proctor	Lot Size
Subgrade	Standard	200 linear feet
Common Fill	Standard	200 linear feet per lift 25 square feet of footing area per lift
Aggregate base course	Modified	200 linear feet per lift 25 square feet of footing area per lift

NOTES
(a) Standard proctor, ASTM D698.
(b) Modified proctor, ASTM D1557.
(c) Lift thickness above pipe zone before compaction, 8 inches.

E. Flowable Fill Strength: Lot size is one (1) day production with sub-lots of 50 cubic yards or part thereof. Verify strength using cylinders, ASTM D4832.

F. Grade, Cross Slope: Measured at random locations.

1.10 **WARRANTY**

A. Correct any settlement of Trench backfill or structures built over Trench backfill at no cost to OWNER.

B. Restore structures damaged by settlement at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13. Granular material, CONTRACTOR's choice.

B. Aggregate base course, Section 32 11 23. Untreated base course.

C. Cement treated fill, Section 31 05 15. Use a flowable fill so vibration is not required.

D. Slag or bitumen bearing material NOT ALLOWED in trench.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

2.3 **GEOTEXTILE FABRIC**

A. Section 31 05 19. Use woven or non-woven stabilization-separation fabric. Select either moderate MARV or high MARV as needed.

2.4 **IDENTIFICATION TAPE**

A. Permanent, bright colored, continuous printed magnetic plastic tape, intended for direct burial service; not less than six (6) inches wide by four (4) mils thick. Tape shall read "**CAUTION: BURIED INSTALLATION BELOW**". Color as follows.

Red	Electric power lines, cables, conduit and lighting cables
Yellow	Gas, oil, steam, petroleum or gaseous materials
Orange	Communications, alarm, signal, cables or conduits
Blue	Potable water
Purple	Reclaimed water, irrigation and slurry lines
Green	Sewer and storm drain lines

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Identify required line, levels, contours, and datum.

C. Stake and flag locations of underground utilities.

D. Verify:

1. Backfill material meets gradation requirements.
2. Foundation walls are braced to support surcharge forces imposed by backfilling operations, areas to be backfilled are free of debris, snow, ice or water.
3. Trench bottom is not frozen.

E. If ground water is in the intended backfill zone, dewater.

3.2 **SUBGRADE**

A. Protect subgrade from desiccation, flooding, and freezing.

B. Before backfilling over Subgrade, get ENGINEER's review of Subgrade surface preparations.

C. If Subgrade is not readily compactable, get ENGINEER's permission to stabilize the subgrade:

1. Excavation for Subgrade stabilization is incidental work, Section 31 23 16.
2. Place geotextile fabric. Place acceptable fill in lifts. Compact.

3.3 **PROTECTION**

A. During installation or repair, plug end of pipe or fitting except when installing next section of pipe or fitting.

B. Movement of construction machinery over Work at any stage of construction is solely at CONTRACTOR's risk.

3.4 **GENERAL BACKFILLING REQUIREMENTS**

A. Avoid injuring and displacement of conduit, pipe and structures while compacting soil or operating equipment next to pipeline.

B. Place geotextile fabrics; Section 31 05 19.

C. Do not damage corrosion protection on pipe.

D. Repair or replace damaged pipe at no additional cost to OWNER.

E. Withdraw sheathing, shoring, piles, and similar supports as backfilling progresses. Backfill and compact all holes left by removals.

F. Provide sufficient water quality facilities to protect downstream fish and wildlife, and to meet State water quality requirements.

G. Water settling of trench backfill is not permitted. "Jetting" of trench backfill is prohibited.

3.5 **PIPE ZONE**

A. Follow APWA Plan 382 requirements.

B Maintain uniform foundation along barrel of pipe with sufficient relief for joint connections.

C. Use backfill materials meeting pipe manufacturer's recommendations. Maximum backfill particle size is 3/4 inch for plastic pipe.

D. Do not permit free fall of backfill material that may damage pipe, pipe finish, or pipe alignment.

E. Except where piping must remain exposed for tests, fill pipe zone as soon as possible.

3.6 **TRENCH ABOVE PIPE ZONE.**

A. Follow APWA Plan 381 requirements.

B. Maximum lift thickness before compaction is eight (8) inches.

C. Fill unauthorized excavations with material acceptable to ENGINEER at no additional cost to OWNER.

D. Do not damage adjacent structures or service lines.

E. Install continuous identification tape directly over buried lines 18 inches below finished grade.

3.7 **MODIFIED BACKFILL LAYER METHOD**

A. At discretion of CONTRACTOR, backfill may be placed in thicker layers than indicated above subject to the following provisions:

1. CONTRACTOR proves the ability of proposed method to achieve specified average compaction density.
2. ENGINEER, on the basis of test results, approves the system in writing.

B. Should CONTRACTOR find it necessary to change the method or any part of it, including the source of material, or the rate of placing the material, obtain approval of ENGINEER, who may require a further trial area.

C. If testing shows a previously approved system is no longer producing the required degree of compaction, make changes to comply.

D. Where vibration effects are creating environmental problems, make changes to eliminate problems.

3.8 **TOLERANCES**

A. Compaction: Ninety-five (95) percent or greater relative to a standard or modified proctor density, Section 31 23 26.

B. Lift Thickness (before compaction):

1. Eight (8) inches when using riding compaction equipment.
2. Six (6) inches when using hand held compaction equipment.
3. As proven in the modified backfill layer method.

C. Cement Treated Fill: Compressive strength targets are 60 psi in 28 days and 90 psi maximum in 28 days.

3.9 **FIELD QUALITY CONTROL**

A. Test trench backfilling until a compaction pattern acceptable to CONTRACTOR and

ENGINEER is achieved. Continue random quality control compaction testing.

3.10 **SURFACE FINISHING**

A. Provide temporary paved surfaces where trenches pass through roadways, driveway approaches or sidewalks.

B. Restore paved surfaces, Section 33 05 25.

C. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grasses.
2. Section 32 93 13 for other ground cover.

D. Repair public and private facilities damaged by CONTRACTOR.

3.11 **CLEANING**

A. Remove stockpiles from site when work is complete. Grade site to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 33 31 00
SANITARY SEWERAGE SYSTEMS

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Installation of a buried non-pressure sanitary sewer pipe system.

B. Refer to Section 33 11 00 if installation is a pressurized pipe system.

1.2 **REFERENCES**

A **APWA (Utah) Standards**:

Plan 255 Bituminous concrete T-patch Plan 256 Concrete pavement patch Plan 381 Trench backfill

Plan 382 Pipe zone backfill

Plan 411 Sanitary sewer manhole Plan 431 Sewer lateral connection

B. **ASTM Standards**:

C478 Precast Reinforced Concrete Manhole Section. C891 Installation of Underground Precast Concrete Utility Structures.

C923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.3 **DEFINITIONS**

A. **Non-pressure Pipe System**: Defined in Section 33 41 00.

1.4 **PERFORMANCE REQUIREMENTS**

A. Vertical Cover: Unless indicated otherwise, provide at least two (2) feet of protection cover during construction.

B. Remove any section of pipe already placed that is found to be out of alignment tolerance, defective, or damaged. Relay or replace at no additional cost to OWNER.

1.5 **SUBMITTALS**

A. Product data: Submit manufacturer's technical product data and installation instructions.

B. Commissioning: Provide Section 33 08 00 submittals.

C. Site conditions minimize neighborhood traffic interruptions. Barricade stockpiles.

D. Provide access to adjacent properties for local traffic and pedestrians, Section 01 31 13.

1.6 **ACCEPTANCE**

A. Each sanitary sewer system component must pass applicable commissioning requirements in Section 33 08 00.

PART 2 PRODUCTS

2.1 **PIPES AND FITTINGS**

A. Provide piping materials and factory fabricated piping products of sizes, types, and classes required.

B. Where not indicated, select product acceptable to ENGINEER and comply with installation requirements.

C. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.

2.2 **MORTAR, GROUT AND CONCRETE**

A. Portland cement mortar, Section 04 05 16.

B. Non-shrink grout, Section 03 61 00.

C. Concrete:

1. Cast-in-place: Section 03 30 04.
2. Precast Concrete: Section 03 40 00.

2.3 **MANHOLES**

A. Basin: Concrete floor and walls, or ASTM C478 precast concrete.

B. Steps: None.

C. Top: Concentric cone. Concentric flat slab concrete deck allowed only with ENGINEER's permission.

D. Frame and Cover: Scoriated, asphalt coated, heavy duty, ductile iron Section 05 56 00, with flat top design meeting load rating H-20 and appropriate utility lettering. Shape, size and lifting device as necessary.

E. Pipe Connectors:

1. Precast Bases: Resilient, ASTM C923. Sand mortar grout pipe connections.
2. Cast in Place or Connections to Existing Fixture with Plastic Pipe: Use rubber adapter gasket for precast sections. Grout, Section 03 61 00 for cast in place sections.

F. Joints in Sections: Bituminous mastic gasket-type sealant or otherwise acceptable to ENGINEER.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify Trench Excavation is ready to receive work, and dimensions, and elevations are correct. Commencing installation means acceptance of existing conditions.

B. Hand trim excavations to required elevations. Backfill over excavations and compact, Section 31 23 26.

C. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.

D. Clearly identify and promptly set aside defective or damaged pipe.

E. Use pipe cutting tool acceptable to pipe manufacturer.

3.2 ABANDONED UTILITIES

A. Use concrete to plug and cap openings in abandoned underground utilities that are to remain in place.

B. Provide closures to withstand hydrostatic or earth pressure that may result after abandoned utilities have been closed.

3.3 INSTALLATION - PIPE AND FITTINGS

A. Install pipe and fittings per APWA Plan 382.

B. Place bell or groove end facing upstream.

C. Install gaskets per manufacturer's recommendations.

D. Plug pipeline branches, stubs or other open ends that are not to be immediately connected.

E. Clean interior of pipe of dirt and debris as work progresses.

F. Meet line and grade tolerance in Section 33 08 00. Use a laser device or demonstrate an equivalent method of establishing line and grade.

3.4 INSTALLATION - JOINTS

A. Join pipe per manufacturer's recommendation.

B. Join pipe of different sizes at manholes only.

C. Use neoprene couplings with stainless steel bands to make connections between dissimilar pipe, or where standard pipeline joints are impractical.

3.5 INSTALLATION - MANHOLES

A. Install manholes per APWA Plan 411.

B. Form bottom of excavation clean and smooth to correct elevation.

C. Place structures in location indicated.

D. Provide elevations and pipe inverts for inlets and outlets indicated.

E. When structures occur in Pavements, mount frame and cover 1/2 inch below finished surface. Provide a concrete Cover Collar between the frame and bituminous Pavement. Elsewhere set frame and cover three (3) inches above finished grade.

3.6 **INSTALLATION - TAP CONNECTIONS-6 INCHES AND SMALLER**

A. Install connections per APWA Plan 431.

B. Field cutting into new or existing piping will not be permitted unless written permission is obtained from ENGINEER.

C. Make connections to existing pipe and underground structures, so connections will conform as nearly as practicable to requirements specified for new work.

D. Use commercially manufactured wyes for branch connections. Spring wyes into existing line and encase entire wye, plus six (6) inches overlap, with not less than six (6) inches of concrete.

E. For taps into existing 24 inches or larger piping, or to underground structures, cut opening into unit sufficiently large to allow three (3) inches of concrete to be packed around entering connection. Cut ends of connection passing through pipe or structure wall to conform to shape of and parallel with inside wall, unless otherwise indicated. Grout connection to provide smooth transition inlet into pipe.

3.7 **INSTALLATION - TAP CONNECTIONS-LARGER THAN 6 INCHES**

A. Not allowed. Provide a Manhole structure per APWA Plan 411.

3.8 **BACKFILLING**

A. Trench Backfill: Place backfill per Section 33 05 20. Provide product and placement indicated in the following Standard Plans.

1. APWA Plan 382 for pipe zone backfill.
2. APWA Plan 381 for trench backfill above pipe zone.

B. Landscape and Structural Backfill: Place backfill per Section 31 23 23. Provide product and placement indicated.

C. Repair public and private facilities damaged by CONTRACTOR.

3.9 **SURFACE FINISHING**

A. Roadway Trenches and Patches: Restore pavement patches per Section 33 05 25. Provide product and placement indicated in the following standard plans.

1. APWA Plan 255 for bituminous pavement T-patch.
2. APWA Plan 256 for Portland cement concrete pavement patch.

B. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grass cover.

2. Section 32 93 13 for other ground cover.

C. Repair public and private facilities damaged by CONTRACTOR.

3.10 **COMMISSIONING**

A. Before surface finishing, commission pipeline per Section 33 08 00. Provide sizes and types of equipment connections and fittings that match pipe materials when pressure testing system.

B. If paved surfaces must be kept open prior to commissioning, provide temporary paved surfaces.

3.11 **CLEANING**

A. Remove debris, concrete, or other extraneous material that accumulates in existing pipes or structures.

B. Clean all pipelines after testing. Do not flush sand, gravel, concrete, debris or other materials into existing piping systems.

END OF SECTION

SECTION 33 41 00
DRAINAGE SYSTEMS

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Installation of a buried non-pressure pipe system such as a storm drain, a sub-drain, irrigation, etc.

B. Refer to Section 33 11 00 if the installation is a pressurized pipe system.

1.2 **REFERENCES**

A **APWA (Utah) Standards**:

Plan 255 Bituminous concrete T-patch

Plan 256 Concrete pavement patch

Plan 315 Catch basin (single or double grate)

Plan 317 Curb face inlet box

Plan 322 Curb face outlet box

Plan 323 Pipe outfall

Plan 331 Cleanout box

Plan 341 Precast manhole

Plan 381 Trench backfill

Plan 382 Pipe zone backfill

B. **ASTM Standards**:

C 478 Precast Reinforced Concrete Manhole Section.

C 923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.3 **DEFINITIONS**

A. **Non-pressure Pipe System**: Pipelines with joints that have no leakage after a sustained hydraulic pressure not exceeding 10.8 psi (22 in. Hg) for 10 minutes or a sustained vacuum pressure not exceeding 3 kPa (5 in. Hg) for 10-minutes.

1.4 **PERFORMANCE REQUIREMENTS**

A. Vertical Cover: Unless indicated otherwise, provide at least two (2) feet of protection cover during construction.

B. Remove any section of pipe already placed that is found to be out of alignment tolerance, defective, or damaged. Relay or replace without additional cost to OWNER.

1.5 **SUBMITTALS**

A. Product data: Submit manufacturer's technical product data and installation instructions.

B. Commissioning: Provide Section 33 08 00 submittals.

1.6 **SITE CONDITIONS**

A. Minimize neighborhood traffic interruptions. Barricade stockpiles.

B. Provide access to adjacent properties for local traffic and pedestrians, Section 01 31 13.

1.7 **ACCEPTANCE**

A. Each drainage system component must pass applicable commissioning requirements in Section 33 08 00.

PART 2 PRODUCTS

2.1 **PIPES AND FITTINGS**

A. Provide piping materials and factory fabricated piping products of sizes, types, and classes required.

B. Where not indicated, select product acceptable to ENGINEER and comply with installation requirements.

C. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.

2.2 **IN-PLANE WALL DRAINAGE**

A. Drainage Core: Manufacturer's standard three-dimensional non-bio- degradable, plastic designed to effectively conduct water to foundation drainage system.

B. Filter Fabric: Manufacturer's standard non-woven geotextile fabric of polypropylene or polyester fibers, or combination.

2.3 **SUB DRAIN FILL MATERIALS**

A. Sewer rock, Section 32 11 23 and geotextile, Section 31 05 19.

2.4 **MORTAR, GROUT AND CONCRETE**

A. Portland cement mortar, Section 04 05 16.

B. Non-shrink grout, Section 03 61 00.

C. Concrete:

1. Cast-in-place: Section 03 30 04.
2. Precast Concrete: Section 03 40 00.

2.5 **MANHOLES**

A. Basin: Concrete floor with cast in place concrete walls or ASTM C478 precast concrete.

B. Steps: None.

C. Top: Concentric cone. Concentric flat slab concrete deck allowed only with ENGINEER's permission.

D. Frame and Cover: Scoriated, asphalt coated, heavy duty, ductile iron Section 05 56 00, with flat top design meeting load rating H-20 and appropriate utility lettering. Shape, size and lifting device as necessary.

E. Pipe Connectors:

1. Precast Bases: Resilient, ASTM C923. Sand mortar grout pipe connections.
2. Cast in Place or Connections to Existing Fixture with Plastic Pipe: Use rubber adapter gasket for precast sections. Grout, Section 03 61 00 for cast in place sections.

F. Joints in Sections: Bituminous mastic gasket-type sealant or otherwise acceptable to ENGINEER.

2.6 **INLETS, CATCH BASINS, CLEANOUTS**

A. Basin: Concrete floor and walls.

B. Pipe Connectors: Resilient, ASTM C923. Sand mortar grout.

C. Frame and Grate:

1. Asphalt coated, heavy duty, cast iron, Section 05 56 00. Shape and size indicated.
2. Galvanized, heavy duty, steel: Sections 05 12 00 and 05 05 10. Shape and size as indicated.

2.7 **OUTFALLS**

A. Cast-in-place or precast concrete with reinforced headwall, apron, and tapered sides. Provide riprap, Section 31 37 00, if indicated.

2.8 **DRAIN PIPE JOINT SCREENS**

A. Heavy mesh burlap, coal-tar saturated felt, 18 to 14 mesh copper screening or synthetic drainage fabric.

B. Plastic or corrosion resistant metal bands.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Verify Trench Excavation is ready to receive work, and dimensions, and elevations are correct. Commencing installation means acceptance of existing conditions.

B. Hand trim excavations to required elevations. Backfill over excavations and compact, Section 31 23 26.

C. Remove stones larger than two (2) inches or other hard matter that could damage pipe or impede backfilling or compaction.

D. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.

E. Clearly identify and promptly set aside defective or damaged pipe.
F. Use pipe cutting tool acceptable to pipe manufacturer.

3.2 **ABANDONED UTILITIES**

A. Use concrete to plug and cap open ends of abandoned underground utilities that are to remain in place.
B. Provide closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.

3.3 **INSTALLATION - PIPE AND FITTINGS**

A. Place bell or groove end facing upstream.
B. Install gaskets per manufacturer's recommendations.
C. Plug pipeline branches, stubs or other open ends that are not to be immediately connected.
D. Clean interior of pipe of dirt and debris as work progresses.
E. Insulate dissimilar metals from direct contact with each other using neoprene gaskets or asphalt coatings.
F. Meet line and grade tolerance in Section 33 08 00. Use a laser device or demonstrate an equivalent method of establishing line and grade

3.4 I**NSTALLATION - JOINTS**

A. Join pipe per manufacturer's recommendation.
B. Join pipe of different sizes at manholes or cleanouts only.
C. Use neoprene couplings with stainless steel bands to make connections between dissimilar pipe, or where standard pipeline joints are impractical.

3.5 **INSTALLATION - MANHOLES**

A. Install manholes per APWA Plan 341.
B. Form bottom of excavation clean and smooth to correct elevation.
C. Place structures in location indicated.
D. Provide elevations and pipe inverts for inlets and outlets indicated.
E. When structures occur in Pavements, mount frame and cover 1/2 inch below finished surface. Provide a concrete Cover Collar between the frame and bituminous concrete pavement. Elsewhere set frame and cover three (3) inches above finished grade.

3.6 **INSTALLATION - INLETS, CATCH BASINS, CLEANOUTS**

A. Install facilities per APWA Plans 315, 316, 317, 331.
B. Form bottom of excavation clean and smooth to correct elevation.
C. Construct with all connecting piping and appurtenances in their final position.
D. Cut all piping parallel to interior surface wall. Grout connection to provide smooth transition inlet into pipe.

3.7 **INSTALLATION SUB DRAIN SYSTEMS**

A. Install pipe and fittings per manufacturer's requirements.

B. Open Joint Systems: Loosely butt pipe ends. Place 12 inches wide filter fabric around pipe circumference, centered over joint.

C. Mechanical Joint Perforated Pipe System: Place pipe with perforations facing down.

D. Place drainage pipe on bed of sewer rock, Section 31 05 13.

3.8 **INSTALLATION - TAP CONNECTIONS**

A. Not allowed in storm drain systems. Provide a cleanout or manhole structure.

3.9 **INSTALLATION - OUTFALLS**

A. Install outfalls per APWA Plans 322 and 323.

3.10 **INSTALLATION - AREA DRAINS**

A. Install area drains per APWA Plan 372.

3.11 **BACKFILLING**

A. Trench Backfill: Place backfill per Section 33 05 20. Provide product and placement indicated in the following Standard Plans.

1. APWA Plan 382 for pipe zone backfill.
2. APWA Plan 381 for trench backfill above pipe zone.

B. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grass cover.
2. Section 32 93 13 for other ground cover.

C. Repair public and private facilities damaged by CONTRACTOR.

3.12 **SURFACE FINISHING**

A. Roadway Trenches and Patches: Restore pavement patches per Section 33 05 25. Provide product and placement indicated in the following standard plans.

1. APWA Plan 255 for bituminous pavement T-patch.
2. APWA Plan 256 for concrete pavement patch.

B. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grass cover.
2. Section 32 93 13 for other ground cover.

C. Repair public and private facilities damaged by CONTRACTOR.

3.13 **COMMISSIONING**

A. Before surface finishing, commission pipeline per Section 33 08 00. Provide sizes and types of equipment connections and fittings that match pipe materials when pressure testing system.

B. If paved surfaces must be kept open prior to commissioning, provide temporary paved surfaces.

3.14 **CLEANING**

A. Remove debris, concrete, or other extraneous material that accumulates in existing piping or structures.

B. Clean all pipelines after testing. Do not flush sand, gravel, concrete, debris or other materials into existing piping systems.

END OF SECTION