# SPECIFICATIONS

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GENERAL REQUIREMENTS
SECTION 01 11 00
SUMMARY OF THE WORK

PART I - GENERAL

1.01 SECTION INCLUDES

A. Description of the Work
B. Contractor Warrants
C. Contract Document Intent and Relationships
D. University Furnished / Contractor Installed Products
E. Concurrent Work Under Separate Contracts
F. Site Condition Survey and Protection of Existing Improvements
G. Contractor Use of Site and Premises
H. University Beneficial Occupancy (if applicable)
I. Project Phasing (if applicable)

1.02 DESCRIPTION OF THE WORK

A. Project is titled: HOSPITAL SEISMIC UPGRADE- INCREMENT 4 DECOMMISSION NORTH/SOUTH WING
B. UCDHS A/C #: M030667
C. Project is located at 2315 Stockton Blvd, University of California, Davis Health System, Sacramento, California, as shown on the vicinity map.
D. Project Consists of multiple disciplines and a structured work sequence:

This project is to decommission the North/South Wing including severing all remaining utilities except as required by the code and providing barriers to restrict all access into the North/South Wing. The project consists of rerouting remaining plumbing, mechanical and Electrical systems to isolate the North/South Tower infrastructure from the East Tower, construction of all physical barriers to bar all physical access to the North/South Tower and to ready the structure for demolition.

E. A description of areas, types of construction and general nature of the Work are described on drawing G-001 and G-002

The work will be primarily performed during daytime and a normal Monday through Friday work week but there will also be several occasions where night and weekend work will be required to reduce the impact to the active campus and occupied hospital buildings.

F. Build-out as shown and herein specified, complete and ready for occupancy, the following demolition reconstruction and alterations of the facility shown on the Contract Documents.
1.03 CONTRACTOR WARRANTS

A. Contractor warrants that it is skilled and experienced in the use and interpretation of Contract Documents such as those included in the bid documents for this Contract. The Contractor further warrants that it has carefully reviewed the Contract Documents for this Work and has found them to be free of ambiguities and sufficient for bid purposes.

B. Contractor warrants that it has inspected the Project Site and based on these observations, has satisfied itself as to the nature and location of the Work; and any special conditions likely to be encountered at the site which may affect the performance of the Work.

C. Contractor warrants that its bid is based solely on the Contract Documents provided, its own observations, and written explanations and interpretations obtained from University's Representative and not on any explanation or interpretation, oral or written, from any other source.

1.04 CONTRACT DOCUMENT INTENT AND RELATIONSHIPS

A. Contract Documents Intent: Provide all labor, material, equipment, tools, transportation, insurance, services and all other requirements necessary to construct the project described in the Contract Documents.

B. Relationship of Contract Documents: Drawings, Specifications and other Contract Documents in the Contract are intended to be complementary. What is required by one shall be as if required by all. What is shown or required, or may be reasonably inferred to be required, or which is usually and customarily provided for similar work, shall be included in the Work. For example, the drawings may not show every variation of an anchor clip that is required to support a curtain wall from its structural support; it can be reasonably inferred that variations of or additions to these clips are necessary to complete the installation of the working system and therefore all such clips are understood to be included in the Work.

C. Discrepancies in Contract Documents: In the event of error, omission, ambiguity or conflict in the Contract Documents, Contractor shall bring the matter to University's Representative's attention in a timely manner, for University's Consultant's determination and direction in accordance with provisions of the General Conditions of the Contract.

D. Bidding and Contract requirements: Information for bidding, Conditions of the Contract and other Contract documents will be produced by University and may be included in the Contract Documents for convenience. Such documents are not Specifications. Specifications are found in Divisions 1 through 16 of the Contract, as listed in the Table of Contents of the Contract.

E. Contract Drawings: The Drawings provided with and identified in the Contract are the Drawings referenced in the Agreement.

1. Drawings produced for this project may encompass Civil, Landscape, Architectural, Structural, HVAC, Plumbing, Piping, Fire Protection, and Electrical portions of the Work. Interior Design drawings may also be provided for product selection and installation information.
2. The location, extent and configuration of the required construction and improvements are shown and noted on the Drawings. A list of Drawings is included in the Contract Documents.

3. Drawings are arranged according to design discipline. Such organization and all references to trades, subcontractor, specialty contractor or supplier shall not control the Contractor in dividing the work among subcontractors or in establishing the extent of the work to be performed by any trade.

4. Where the terms "as shown", "as indicated", "as noted", "as detailed", "as scheduled" or terms of like meaning, are used in the Drawings or Specifications, it shall be understood that reference is being made to the List of Drawings and the Specifications as bound in the Contract Documents.

5. Where reference to the word "plans" is made anywhere in the Drawings, Specifications and related Contract Documents, it shall be understood to mean the Drawings listed in the List of Drawings.

F. Contract Specifications: The Specifications provided as a part of the Contract Documents are the Specifications referenced in the Agreement.

1. The Specifications are organized by Division and Sections in accordance with recommended practice of the Construction Specifications Institute. Such organization shall not control the Contractor in dividing the work among subcontractors or in establishing the extent of the work to be performed by any trade.

2. Specifications are included in the Contract, which also includes other Bidding and Contract Documents. Contents of the Contract are listed in the TABLE OF CONTENTS.

3. Information for bidding, Conditions of the Contract and other Contract documents will be produced by University. Such documents are not Specifications. Specifications are found in Division 1 through 28 of the Contract.

1.05 UNIVERSITY-FURNISHED, CONTRACTOR-INSTALLED PRODUCTS

A. University-Furnished Products: University will furnish, for installation by Contractor, products which may be identified on the Drawing and in the Specifications as UFCI (University-Furnished / Contractor-Installed).

1. Toilet Room Accessories:
   a. Seat Cover Dispensers
   b. Paper Towel Dispensers
   c. Toilet Paper Dispenser
   d. Soap Dispensers
B. Relationship to Work Under the Contract: Work under the Contract shall include all provisions necessary to fully incorporate such products into the Work, including, as necessary, fasteners, backing, supports, piping, conduit, conductors and other such provisions from point of service to point of connection, and field finishing, as shown on the Drawings and/or Specified herein. See Section 01 31 00 - COORDINATION for additional requirements.

1.06 CONCURRENT WORK UNDER SEPARATE CONTRACTS

A. Work Under Separate Contracts: University will award separate contracts for the following work and other work as may be indicated on Drawings as NIC (Not in Contract), including the following:

1. Test & Balance for Mechanical Systems and Domestic Water System (by MESA3).

2. Programming of Existing Fire Alarm System to integrate new Fire Alarm System (by IES).

3. Programming of Existing Lighting Control System to integrate new Lighting Control System (by JCI).

4. Section 01 39 03 Commissioning Authority (by TBD).

B. Projects Under Separate Contracts:

1. HSU "Increment 1, SEGMENT B Mechanical & Electrical Upgrades" 9559010.

2. HSU "Increment 2 Fire and Life/Safety Upgrades" 9559030.

3. East Wing 7th Floor “E7 PCS Flex Space” Renovation.

4. "UT & East Wing Elevator Upgrades” 9559020

5. “Stair 1 & First Floor Corridor Exit Pathway” Life/Safety project.


C. Relationship to Work and Projects Under the Contract: Work under the Contract shall include all provisions necessary to make such concurrent work and projects under separate contracts complete in every respect and fully functional, including field finishing. Provide necessary backing, supports, piping, conduit, conductors, and other such provisions from point of service to point of connection for additional requirements.

D. Related Contract Documents: University will make available, in a timely manner, Contract Documents of work under separate contracts for coordination and further description of that work. Such drawings and other data required for the coordination of the work of separate contracts with the Work of this Contract may be included with the Contract Documents. If so, they are provided for convenience only and are not to be considered Contract Documents.

1.07 SITE CONDITION SURVEY & PROTECTION OF EXISTING IMPROVEMENTS

A. Site Condition Survey: Prior to commencing work, the Contractor, University's Representative and other University representatives shall tour the Project site together to
examine and record the existing condition of site, adjacent buildings, and improvements. This record shall serve as a basis for determination of damage (if any) due to the construction process. The record shall be signed by all parties participating in the tour.

B. Protection of Existing Improvements: Locate all known existing utilities prior to proceeding with construction. Existing utilities shall be kept in service where possible and protected by the Contractor from damage. If any structure or utility is damaged, take immediate action to ensure the safety of persons and University property and effect repair. If previously undiscovered structures or utilities are encountered, request University's Representative to provide direction on how to proceed with the work. Cracks, sags or damage to adjacent structures or improvements not noted in the original survey shall be reported to University's Representative.

C. University does not normally charge for its shutdown support services. However, if poor planning or execution of a shutdown by Contractor causes excessive time and effort for University, University reserves right to deduct these costs from the Contract total.

1.08 CONTRACTOR USE OF SITE AND PREMISES

A. Site Access: Limit access to site as indicated on the drawings. If routes and access points are not indicated, access shall be as directed or approved by University's Representative.

B. Hours of Operation: Construction activities are typically limited to the hours of 7:00 A.M. to 5:00 P.M., Monday through Friday. Prior University approval is required for Contractor construction work at any other time or day.

C. Construction Limit: Limit construction activities to areas indicated on Drawings as Project Area or, if not indicated, to areas immediately adjacent to buildings and as necessary for immediate construction or utility services and sitework, See Section 01 51 00 - TEMPORARY UTILITIES for additional requirements.

D. Utility Outages and Shutdowns: Schedule utility outages and shutdowns to times and dates acceptable to University's Representative. Duration of outages and shutdowns shall not hinder University normal business operations. Provide fourteen (14) days notice of all utility outages and shutdowns.

1.09 UNIVERSITY BENEFICIAL OCCUPANCY

A. The following portions of the Work are designated for separate occupancy by University as indicated:

1. Basement Therapy / 1st Floor Training Offices.
2. Basement Handicap Ramps.
3. 1st Floor Rooftop HVAC.
4. MEP, FP, LV Decoupling.

1.10 PROJECT PHASING
A. The WORK OF THIS contract is divided into phases:

1. Phase I - Basement Therapy / 1st Floor Training Offices before Move-123.
2. Phase II – Basement Therapy / 1st Floor Training Offices after Move-123.
3. Phase III - MEP, FP, LV Decoupling.

PART II - SCOPE OF WORK REQUIREMENTS

2.01 SPECIFIC REQUIREMENTS

The following Specific Requirements are intended to clarify and/or amplify the requirements of this Contract work scope and DO NOT describe the full extent of the contract work. This Contract includes all work indicated or reasonably inferred by the Contract Documents and as required to provide complete, fully functional and fully operational systems and subsystems. Specific references to drawings, details, specifications, etc., are included below to illustrate the type of work and highlight certain portions of the work only and do not address all of the work if this contract. This Contract also includes the General Conditions, Supplementary Conditions, Division 1 General Requirements, all contract drawings, any addenda or changes to the construction documents, all specification sections required for the performance of the work. Bidders must review all of the Bidding Documents and visit the site to determine the full extent of the Work. This is not a complete definition of work:

1. Spill & Water Damage Prevention - Provide materials at each area of work to address liquid spills, and pipe leaks. Materials include, but are not limited to watertight 50 gallon trashcans, rigid & corrugated PVC pipe, mops, mop buckets, floor squeegees, towels, and plumbing piping configured to divert water from a broken sprinkler head to a trashcan.

2. Hazmat Abatement & In-Place Management – Complete all scope per Contract and:
   a. Perform Hazmat Abatement within areas of construction.
   b. Provide spot Hazmat removal & In-place Hazmat management at all other areas of construction.

3. Temporary Weatherproofing – Provide, install, maintain, and remove all materials required temporarily weatherproof all areas of work. Pre-coordinate and identify areas that will require temporary weatherproofing. Pre-purchase and store weatherproofing materials onsite.

4. Temporary Fall Protection – Field verify, coordinate, design, engineer, install, maintain and remove Cal/OSHA complaint guardrails and anchors, etc. required to perform all the work of this contract. Temporary Guardrails to be equal to Flexible Lifeline (flexiblelifeline.com). Pre-coordinate with all subcontractors to accurately identify areas that will require fall protection.

5. Carts shall be use to move materials & equipment up and down the west ramp. West ramp is approximately, 150’ long and 3% grade. If operating motorized carts at interior or crowded areas, provide an escort that walks in front of the motorized cart at all times. Transport of materials and equipment at the West ramp shall be done per Cal/OSHA standards and project requirements.

6. Path of travel for access/egress at exterior areas –provide, install and maintain temporary scaffold and other access/egress measures as required to comply with Cal/OSHA and ILSMs.

7. Provide Cementitious Spray Fireproofing per Contract, and provide & install Cementitious Fireproofing Patching at all existing structural elements.
8. Roofing - Provide pre-coordination, removal, and repair of existing roofing associated with all roof mounted equipment. Prior to roof demolition, clearly and precisely layout all locations to remove & repair existing roofing. Roof repair methods shall be compatible with existing roofing materials. Provide, install, maintain, and remove effective roof protection measures as required to protect roof membranes and flashing.

9. Provide temporary HVAC Filters per Contract, and if required Provide/Install/Maintain/Remove filter media at all outside air intakes or relief air intakes located within 100LF of exterior areas of construction.

10. Medical Gas Demolition – Comply with requirements of Contract and NFPA 99 to disconnect and cap all medical gas piping. Contractor shall retain the services of an experienced medical gas personnel qualified to install LOKRING medical gas fittings, and certify the medical gas piping capping. The University has used Carstens Yearly Analysis to perform similar disconnect/capping of medical gas piping at UCD Medical Center. [http://www.cyame.com/index.html](http://www.cyame.com/index.html)

11. Per requirements of Cal/OSHA & ILSMs - provide, maintain, replace & remove temporary fire extinguishers for areas under construction for the duration of the project.

12. Provide permanent signage per Contract, and Provide, install, maintain and remove all temporary construction signage required for compliance with CalOSHA, ICRA, and ILSM.

13. Remove all existing signage and all wall mounted items directly related to areas of demolition. As required, repair and repaint damage to existing walls caused by removal of signage and/or wall mounted items.

PART III - EXECUTION – Not applicable to this Section

END OF SECTION 01 11 00
PART I - GENERAL

1.01 DESCRIPTION

A. This Section contains the procedures to be followed by Contractor for submitting a Request for Information (RFI) upon discovery of any apparent conflicts, omissions, or errors in the Contract Documents or Drawings or upon having any question concerning interpretation.

B. Section Includes
   1. RFI Administrative requirements
   2. RFI Procedures
   3. RFI Execution

1.02 RELATED DOCUMENT SECTIONS


B. Section 01 61 00 – PRODUCT REQUIREMENTS: Product options, substitutions, omissions and improper descriptions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Description: Section provides procedure for Contractors to obtain interpretation or clarification of the Contract Documents, or identify apparent conflicts, omissions, or errors in the Contract Documents.

B. Responsible Person for Contractor: Submit name of the individual authorized to receive Requests for Information documents, and who is responsible for forwarding Request.

C. RFI Format: Submit all Requests for Information on the form attached at the back of this Section.

1.04 RFI PROCEDURES

A. RFI Format, Numbering and Subject:
   1. RFI Format: Submit all requests for clarification or additional information in writing to University's Representative using the RFI Request for Information form provided at the back of this Section or obtained from University's Representative.
   2. RFI Numbering: Number RFI's sequentially. Follow RFI number with sequential alphabetical suffix for resubmissions. For example, the first RFI is numbered "001". The second RFI is numbered "002" and so on. The first resubmittal of RFI "002" will be numbered "002a".
   3. RFI Subject: Limit each RFI to one (1) subject only.
B. RFI Submittal conditions:

1. Discovery of unforeseen condition or circumstance not described in the Contract Documents.

2. Discovery of an apparent conflict, discrepancy or inconsistency in or between portions of the Contract Documents.

3. Discovery of a situation, direction or apparent omission that cannot be reasonably inferred from the intent of the Contract Documents.

PART II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION

3.01 EXECUTION OF RFI's

A. Emailed RFI requests are preferred. However faxed RFI requests will be accepted. University's Representative's fax number is 916-734-7751. Notification time begins from date stamp of University's fax machine. Fax RFI requests received after normal business hours and/or received on non-normal workdays, as defined in Specification Section 01 31 00 – COORDINATION, Item 1.07.F.4.A will begin notification time starting at 7:00 AM the following business day.

B. Failure to provide proper information: RFI's will not be recognized or accepted if, in the opinion of University's Representative, one of the following conditions exist:

1. Contractor submits the RFI as a request for substitution.

2. Contractor submits the RFI as a Submittal.

3. Contractor submits the RFI as a Contract Document discrepancy or omission without through review of the Documents (Capricious submission).

4. Contractor submits the RFI assuming portions of the Contract Documents are excluded or by taking an isolated portion of the Contract Document in part rather than in whole.

5. Contractor submits the RFI in an untimely manner without proper coordination and scheduling of Work of other Trades.

C. Response Time: Request clarifications or information immediately upon discovery of need. Submit RFI's in a timely manner allowing full response time to avoid impacting Contract Schedule.

1. University's Representative, whose decision will be final, shall resolve issues and respond to questions of Contractor, in most cases, within fourteen (14) days. Actual time may be lengthened for complex issues, or shortened for expedited situations, as mutually agreed in writing.

2. After submission of an RFI by Contractor and prior to receipt of the RFI response from University, the Contractor proceeds with effected Work at own risk. Any portion of the Work not constructed in accordance with University interpretation, clarification, instruction or decision is subject to removal and replacement at Contractor expense.
D. Failure to Agree: In the event of failure to agree to the scope of the Contract requirements, Contractor shall follow procedures set forth in Article 4 of the General Conditions of the Contract.

END OF SECTION 01 25 00
# REQUEST FOR INFORMATION

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<tr>
<th>A/C #: M030667</th>
<th>Project Title: Decommission North / South Wing</th>
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University of California, Davis Health System  
Facilities Design & Construction  
4800 2nd Avenue, Suite 3010, Sacramento, CA 95817  
Attn.: Dave Brooks  
P: 916-734-0221  
C: 916 439-7958  
F: 916-734-7751  
Email: dcbrooks@ucdavis.edu

**SUBJECT:**

**SPEC SECTION/DRAWING #:**  
**PARA:**  
**DETAIL:**  
**RM #**  
**GRID #**

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<th>TRANSMITTAL RECORD</th>
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<th>FD&amp;C to A/E</th>
<th>A/E to FD&amp;C</th>
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**INFORMATION NEEDED:**

**CONTRACTOR’S PROPOSED RESOLUTION:**

**REQUESTOR SIGNATURE:**  
**REPLY REQUIRED BY:**

**ATTACHMENTS:**

**REPLY:**

**REPONDER SIGNATURE:**  
**DATE:**

---

Unless otherwise indicated above, the reply to this RFI is not intended to be a change directive. Should the contractor, subcontractor, or suppliers feel that the reply will impact the project cost or schedule; it should immediately be conveyed to the UCDMC FD&C Project Manager in accordance with the Contract documents.

**COPIES:** UCDMC CONSULTANTS FILE
SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Change Order Administrative Requirements
B. Documentation of Change in Contract Sum and Contract Time
C. Change Procedures
D. Field Orders
E. Stipulated Sum Change Orders
F. Unit Price Change Orders
G. Time and Material Change Orders
H. Execution of Change Orders
I. Reconciliation of Change Orders

1.2 RELATED DOCUMENT SECTIONS

B. Section 01 25 00 – CLARIFICATION/INFORMATION PROCEDURES
C. Section 01 29 00 – MEASUREMENT AND PAYMENT: Applications for Payment.
D. Section 01 60 00 – PRODUCT REQUIREMENTS: Product Options, substitutions, omissions and improper descriptions.
E. Section 01 77 00 – CLOSEOUT PROCEDURES: Project record documents.

1.3 CHANGE ORDER ADMINISTRATIVE REQUIREMENTS

A. Responsible Person for Contractor: Submit name of the individual authorized to receive construction change documents, and who is responsible for informing others in Contractor’s employ of subcontractors of changes in the work.

B. Forms found in the Exhibits of the Contract:
   1. COST PROPOSAL Form
   2. COST PROPOSAL SUMMARY Form
3. SUPPORTING DOCUMENTATION FOR THE COST PROPOSAL SUMMARY Form

4. CHANGE ORDER Form

1.4 DOCUMENTATION OF CHANGE IN CONTRACT SUM AND CONTRACT TIME

A. Documentation of Changes in Contract Sum and Contract Time: Provide full information required for evaluation of proposal of proposed changes and to substantiate costs of changes in the Work.

1. Maintain detailed records of Work completed on time and material basis.

2. Document each quotation for a change in Contract Sum and Contract Time with sufficient data to allow evaluation of the quotation.

B. Additional Data: Upon request, provide additional data to support computations.

1. Quantities of products, labor and equipment.

2. Taxes, insurance and bonds.

3. Overhead and profit.

4. Justification for change in Contract Time, if claimed.

5. Credit for deletions from Contract, similarly documented.

1.5 CHANGE PROCEDURES

A. University's Supplemental Instructions: Minor changes in the Work, not involving adjustments to the Contract Sum or Contract time, as authorized by the General Conditions of the Contract, may be presented using Supplemental Instructions or correspondence containing similar information.

B. University Initiated Changes: A "Request for Proposal" may be issued by University's Representative, which includes a detailed description of a proposed change with supplementary or revised Drawings and Specifications.

1. The Request for Proposal may include an estimate of additions or deductions in the Contract Sum or Contract Time for executing the change and may include stipulations regarding overtime work and the period of time the requested response from the Contractor shall be considered valid.

2. Contractor shall prepare and submit a response to the Request for Proposal within fourteen (14) days.

C. Contractor initiated Changes: Contractor may propose a change by submitting a request for change to University's Representative, describing proposed change and its full effect on the Work.

1. Include statement describing reason for change, and full description of effects on Contract Sum, Contract Time, related Work and work being performed under separate contracts.
2. Requests for substitutions shall be included under this category, with procedures as specified in Section 01 60 00 – PRODUCT REQUIREMENTS.

1.6 FIELD ORDER

A. Field Order: University's Representative may issue a "Field Order", signed by University's Representative, instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. The document will describe changes in the Work, and will designate the method of determining what, if any, change is due in the Contract Sum or the Contract Time.

2. Promptly execute the change in the Work.

B. Cost and Time Resolution: Costs and time adjustments for changes in the Work shall be per provisions of the General Conditions of the Contract, unless otherwise agreed to prior to issuance.

1.7 CHANGE ORDERS

A. Stipulated Sum Change Orders: Contractor's response to Request for Proposal or Field Order will be considered and a mutually acceptable adjustment in Contract Sum and Contract Time will be determined. Change Order for this stipulated amount will be prepared by University's Representative for execution by University and Contractor.

B. Unit Price Change Order: Change Order will be prepared by University's Representative for execution by University and Contractor, based on mutually acceptable quantities and pre-determined unit prices.

1. For unit cost or quantities not pre-determined, the Work shall be accomplished under a Stipulated Sum Change Order, if there is no dispute over the estimated or stipulated maximum cost and time for the change.

2. If the amounts are not defined or are disputed, a Field Order will be prepared and issued by University's Representative.

C. Time and Material Change Orders: As directed for changes for where amounts are not defined or are disputed, Contractor shall execute the Work, keeping accurate records of time, both labor and calendar days, and cost of materials.

1. Contractor shall prepare and submit an itemized account and supporting data after completion of the change, within the time limits indicated in the Conditions of the Contract.

2. University's Representative will determine the change allowable in Contract Sum and Contract Time, as provided elsewhere in the Contract Documents, and make recommendation to University for acceptance of Change Order.

3. Contractor shall provide full information as required and requested for evaluation of proposed changes, and to substantiate costs for changes in the Work.

PART 2 - PRODUCTS – Not Applicable to this Section
PART 3 - EXECUTION

3.1 EXECUTION OF CHANGE ORDERS

A. Execution of Change Orders: University's Representative shall prepare Change Order documents for signature by parties' as provided in the Conditions of the Contract.

3.2 RECONCILIATION OF CHANGE ORDERS

A. Schedule of Values: Promptly revise the Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjustment to the Contract Sum.

B. Schedules: Upon completion of the Change Order, promptly revise progress schedules to reflect changes in Contract Time, revising sub-schedules to adjust time for other items of Work as may be affected by the change. Submit revised schedules with next Application for Payment.

END OF SECTION 01255
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Procedures for preparation and presentation of Application for Payment.

1.2 RELATED DOCUMENTS AND SECTIONS

A. GENERAL CONDITIONS of the Contract: Progress Payments and Final Payment.
B. Section 01 32 00 – CONTRACT SCHEDULES
C. Section 01 77 00 – CLOSEOUT PROCEDURES

1.3 PAYMENT APPLICATION FORM

A. Payment Application Form: Prepare Applications for Payment using Exhibit 4 provided in the Contract or, if otherwise directed, prepare Applications for Payment on AIA Document G702 – Application and Certification for Payment; include continuation sheets as necessary, using AIA Document G703 – Continuation Sheet.

1.4 PREPARATION OF APPLICATIONS

A. Preparation of Applications for Payment: The following requirements supplement the provisions of the General Conditions of the Contract. Refer to the GENERAL CONDITIONS OF THE CONTRACT.

1. Present required information typewritten on the required forms. Media-driven forms are acceptable.

2. Execute certification by wet ink signature of authorized officer of the Contractor.

3. Use data from the approved Schedule of Values. Provide dollar value in each column of application for each line item and portion of Work performed and for products stored, if permitted.

   a. List value of each major item of Work and each subcontracted item of Work as a separate line item to serve as a basis for computing values for progress Payments. Round off values to nearest dollar. Listed items of work shall be identified by Specification Section number.

   b. List products and operations of each major subcontract as separate line item.

   c. Include Work Allowances (if any) within line item of Work.

   d. Coordinate listings with Progress Schedule.

   e. Component listings shall each include a directly proportional amount of Contractor’s overhead and profit.
f. For items on which payments will be requested for stored products. List sub-values for cost of stored products with taxes paid.

g. Submit a sub-schedule for each separate Phase of Work specified in Section 01 11 00 – SUMMARY OF THE WORK. Include scheduling of sequences for Phase of the Work as indicated in the Contract Documents.

h. The sum of values listed shall equal total Contract Sum.

4. List each authorized Change Order as an extension on the continuation sheet, listing the Change Order number and dollar value as for an original item of Work. Change Order shall be broken down same as Application for Payment.

5. No Change Order shall be included with Application for Payment until approved in writing by University and University's Representative.

B. Final Payment: Prepare Application for Final Payment as specified in Section 01 77 00 – CLOSEOUT PROCEDURES.

1.5 SUBMISSION OF APPLICATIONS FOR PAYMENT

A. Submission of Applications for Payment: The following requirements supplement provisions of the General Conditions of the Contract. Refer to the GENERAL CONDITIONS OF THE CONTRACT.

1. Submit five (5) copies of each Application for Payment with original wet ink signature. Round values to nearest dollar or as specified for the Schedule of Values.

2. Submit an updated Construction Progress Schedule with each Application for Payment and specified in Section 01 32 00 – CONTRACT SCHEDULES.

3. Submit one (1) copy of the Schedule of Values in accordance with the General Conditions of the Contract. Form and content shall be acceptable to University. Transmit under transmittal letter. Identify Project by A/C # and name.

a. List installed value of each major item of Work and for each subcontracted item of Work as a separate line item to serve as a basis for computing values for Progress Payments. Round off values to nearest dollar. Listed items of Work shall be identified by Specification section number.

b. For each major subcontract list products and operations of that subcontract as separate line items.

c. Coordinate listings with Progress schedule.

d. Component listings shall each include a directly proportional amount of Contractor's overhead and profit.

e. For items on which payments will be requested for stored products, list sub-values for cost of stored products with taxes paid.
f. Submit a sub-schedule for each separate Phase of Work specified in Section 01 11 00. Include scheduling of sequences within each phase indicated on the drawings.

g. The Sum of values listed shall equal total Contract Sum.

h. When University's Representative requires substantiating information, submit data justifying line item amounts in question.

i. Provide one (1) copy of data with cover letter for each copy of Application. Show Application number and date, and line item by number and description.

4. Submit Applications for Payment, Continuation Sheets and Schedule of Values under transmittal letter. Contractor shall identify all payment application documents by University's Project Name and University's A/C number.

1.6 SUBSTANTIATING DATA

A. University's Representative may request substantiating information. Submit data reconciling line item amounts in question.

B. Provide one (1) copy of data with cover letter for each copy of submittal. Show Application number and date and line item by number and description.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 29 00
PART I - GENERAL

1.01 SECTION INCLUDES

A. Project Meetings
B. Submittals Requirements
C. General Contractor Coordination
D. Coordination of Subcontractor and Separate Contracts
E. University Criteria

1.02 RELATED REQUIREMENTS

A. Section 01 11 00 – SUMMARY OF THE WORK: Description of Contract Documents.
B. Section 01 32 00 – CONTRACT SCHEDULES
C. Section 01 33 00 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
D. Section 01 35 00 – SPECIAL PROCEDURES: Interim Life Safety Measures (ILSM).
E. Section 01 45 00 – QUALITY CONTROL
F. Section 01 45 05 – INSPECTION OF WORK
G. Section 01 51 00 – TEMPORARY UTILITIES
H. Section 01 52 00 – CONSTRUCTION FACILITIES
I. Section 01 55 00 – VEHICULAR ACCESS AND PARKING: Traffic Regulation.
J. Section 01 56 00 – TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS
K. Section 01 61 00 – PRODUCT REQUIREMENTS
L. Section 01 73 00 – CUTTING AND PATCHING
M. Section 01 77 00 – CLOSEOUT PROCEDURES: Coordination of completion reviews, inspections and submission of documents.
N. Section 01 78 00 – CLOSEOUT SUBMITTALS: Record Drawings.
1.03 MEETINGS

A. Pre-Construction/Site Mobilization Conference: University's Representative will administer site mobilization conference at Project site for clarification of responsibilities of University, University's Representation and Contractor, use of site and for review of administrative procedures. Site mobilization conference shall be held within fourteen (14) days of Notice to Proceed, unless otherwise directed by University's Representative.

1. Agenda: Pre-Construction/Site Mobilization Conference shall cover the following topics at a minimum:

   a. Special Project Procedures: Implementation of requirements as specified in Section 01 31 00 – COORDINATION.

   b. Subcontractors List: Distribute and discuss list of subcontractors and suppliers.

   c. Construction Schedule: Distribute and discuss initial construction schedule and critical work sequencing of major elements of Work, including coordination of University furnished/Contractor installed (UFCI) products and work under separate contracts, by utility agencies and companies and University.

   d. Designation of Key personnel: Designate key personnel and update project directory for University, University's Consultants, Contractor, major subcontractors, major materials suppliers, serving utility agencies and companies, other contractors performing work under separate contracts and governing authorities having jurisdiction.

   e. Project Communication Procedures: Review requirements and administrative requirements for written and oral communications.

   f. Change Procedures: Review requirements and administrative procedures for Change Orders, Field Orders, University's Representative's Supplemental Instructions, and Contractor's Requests for Information.

   g. Coordination: Review requirements for Contractor's coordination of Work; review sequence and schedule for work being performed for University under separate contracts.

   h. Submittals Administration: Review administrative procedures for shop drawings, project data and sample submittals and review of preliminary submittals schedule.

   i. Project Record Drawings: Review requirements and procedures for project record drawings and specifications.

   j. Construction Facilities and Temporary Utilities: Designate storage and staging areas, construction office areas; review temporary utility provisions; review University requirements for use of premises.

   k. Materials and Equipment: Review substitution requirements; review schedule for major equipment purchases and deliveries; review materials and equipment to be provided by University (UFCI products).
l. Site Access by University's Representative and University's Consultants: Review requirements and administrative procedures Contractor may institute for identification and reporting purposes.

m. Testing and Inspection: Review tests and inspections by independent testing and inspection agencies, manufacturers, and governing authorities having jurisdiction.

n. Permits and Fees: Review Contract requirements; review schedule and process for obtaining permits and paying fees.

B. Billing Meetings: A billing meeting will be conducted by the University's Representative each month prior to submittal of the Application for Payment. Agenda: review of the percent complete relating to the submitted Schedule of Values.

C. Progress Meetings: Progress meetings shall be periodically scheduled throughout progress of the Work. Frequency shall be as determined necessary for progress of Work. Generally, it is intended progress meetings be held once a week as designated by the University's Representative.

1. Administration: University's Representative shall make physical arrangements for meetings and prepare agenda with copies for participants, preside at meetings, record minutes and distribute copies within four (4) days to Contractor University's Consultants, and other participants affected by decisions made at meetings.

2. Attendance: Contractor's Project Manager and jobsite Superintendent shall attend each meeting. Contractor's subcontractors and suppliers may attend as appropriate to subject under discussion. University will have a representative at each meeting. University's Consultants, as appropriate to agenda topics for each meeting and as provided in University/Consultant Agreement, will also attend.

a. Suggested Agenda for Progress Meetings:

1) Building Code/Fire Marshal Issues
2) Design Issues
3) Submittals and Long Lead Items
4) Request for Information
5) Safety Issues
6) Scheduling Status/2 Week Look Ahead
7) Inspection Requests
8) Utility Shutdowns and Dig Notifications
9) Instructional Bulletins and Field Orders
10) Change Orders/Cost Proposals
11) Payment Applications and As-Built Drawings
12) Miscellaneous Business

13) Other items affecting progress of the Work

D. Guarantees, Bonds, Service and Maintenance Contracts Review Meeting: Eleven months following the date of Substantial Completion, a meeting will be conducted by University's Representative to review the guarantees, bonds and service and maintenance contracts for materials and equipment.

E. In addition to meetings listed above, Contractor shall hold coordination meetings and pre-installation conferences to assure proper coordination of Work.

F. Pre-installation Conferences: When required in individual Specification Sections, convene a pre-installation conference prior to commencing Work.

   a. Require attendance by representatives of firms whose activities directly affect or are affected by the Work specified.

   b. Review conditions of installation, preparation and installation procedures and coordination with related Work and Work under separate contracts.

G. Location of all meetings will be as designated by University’s Representative. Participants at all meetings shall be University’s Representatives, Consultants and/or Vendors, Contractor, Superintendent, Subcontractors and others as appropriate.

1.04 SUBMITTALS

A. Coordination of Submittals: Schedule and coordinate submittals as specified in Section 01 33 00 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES, Section 01 77 00 – CLOSEOUT PROCEDURES and Section 01 78 00 – CLOSEOUT SUBMITTALS.

   1. Coordinate submittal effort of various trades, subcontractors and suppliers having interdependent responsibilities for installing, connecting, and placing into service such equipment, materials or installations as necessary for the Work.

   2. Coordinate requests for substitutions to assure compatibility of space, operating elements, and effect on work of others.

   3. Contractor shall submit the following submittals to the University’s Representative who will forward directly to the appropriate State Agencies for their review and approval:

      a. Fire Protection Drawings: Refer to Section 21 13 13.

      b. Fire Alarm System: Refer to Section 28 31 11.

      c. Aluminum Cross Over Stair: Section 05 51 00

B. Coordination/Engineering Drawings: Submit in accordance with Section 01 33 00 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES and as specified herein.

C. Work Plans: Submit as specified herein.

D.
1.05 COORDINATION

A. Coordination: Contractor shall coordinate the Work as stated in the General Conditions of the Contract. Work of the Contract includes coordination of the entire work of the Project, from beginning of construction activity through Project closeout and warranty periods. Contractor shall also coordinate Work under the Contract with work under separate contracts by University. Contractor shall cooperate with University and others as directed by University's Representative in scheduling and sequencing the incorporation into the Work of University Furnished/Contractor Installed (UFCI) products identified in the Contract Documents.

1. Coordinate completion and cleanup of work of the separate trades, subcontractors, vendors, etc., in preparation for University occupancy

2. After University occupancy, coordinate access to site by various trades, subcontractors, vendors, etc., for correction of defective work and/or work not in accordance with Contract Documents, to minimize University disruption.

3. Assemble and coordinate closeout submittals specified in Section 01 77 00 – CLOSEOUT PROCEDURES.

B. Construction Interfacing and Coordination: Layout, scheduling and sequencing of Work shall be solely Contractor's responsibility. Contractor shall bring together the various parts, components, systems and assemblies as required for the correct interfacing and integration of all elements of Work. Contractor shall coordinate Work to correctly and accurately connect abutting, adjoining, overlapping and related elements, including work under separate contracts by University and utility agencies, if any.

C. Installation of Systems into Project Space: Follow routings shown for pipes, ducts and conduits as closely as practicable, as shown on the Contract Documents with due allowance for available physical space; make runs parallel with line of building. Utilize space efficiently to maximize accessibility for other installations, future maintenance and repairs. In finished areas, except as otherwise shown, conceal pipes, ducts and wiring in the construction. Coordinate locations of fixtures and outlets with finish elements.

D. Utility Work: Work occurring on or in the immediate vicinity of critical utilities must be directly supervised at all times by Contractor's qualified personnel. Requirements stated herein for notification, work plans, dig notification forms and marking locations of existing utilities shall apply. Contractor will be held fully liable for costs and damages due to unplanned interruption of critical utilities, including any personal injury to Hospital patients, visitors or staff.

1. Provide supervision and coordination necessary to meet requirements of electrical power connection as set forth by the Sacramento Municipal Utility District (SMUD).

2. Provide reasonable and convenient staging and access areas to permit SMUD, its vendors or subcontractors, to install, modify or remove electrical transformers or other components of the electrical power system furnished and installed by SMUD.

1.06 COORDINATION OF SUBCONTRACTORS AND SEPARATE CONTRACTS

A. Conflicts: Conflicts shall be resolved by the Contractor. Contractor bears primary responsibility for conflict resolution regarding the coordination of all building trades,
subcontractors and suppliers.

B. Superintendence of Work: Contractor shall appoint a field superintendent who shall direct, supervise, and coordinate all Work in the Contract Documents.

C. Subcontractors, Trades and Materials Suppliers: Contractor shall require all subcontractors, trades, crafts and suppliers to coordinate their portions of Work with the Superintendent to prevent scheduling, sequencing, dimensional and other conflicts and omissions.

D. Coordination with Work Under Separate Contracts: Contractor shall coordinate and schedule Work under Contract with work being performed for Project under separate contracts by University. Contractor shall make direct contacts with parties responsible for work of the Project under separate contracts, in order to provide timely notifications and to facilitate information exchanges.

E. Service Connections: Except as otherwise indicated, final connection of mechanical services to general work is defined as being mechanical work; final connection of electrical services to general work is defined as electrical work.

1.07 UNIVERSITY CRITERIA

A. During the Base Construction time, Contractor shall allow University 14 calendar days to move University equipment and/or provide furnishings in areas listed below. Contractor shall notify University's Representative in writing a minimum of fourteen (14) calendar days prior to start or completion of areas described herein.

1. Contractor shall show University activities and Contractor notification as separate activities on the detailed project schedule.

B. Equipment Coordination: Contractor and University supplied equipment will require complete installation data be exchanged directly between Contractor and vendors and subcontractors involved as progress of Project requires. Individual requesting information shall advise when it is required. Incorrect, incomplete, delayed or improperly identified equipment causing delay or error in installation will require entity causing such action to be liable for modifications or replacements necessary to provide correct and proper installation, including relocations.

C. Contractor shall provide large scale equipment drawings for casework and equipment service rough-in locations (dimensioned from building features), service characteristics, and locations of studs or blocking where such locations are critical to mounting or otherwise installing equipment. Furnish sizes and spacing required for mechanical and electrical cutouts, and a complete brochure of fittings, sinks, outlets, or other information to provide a complete assemblage of the items and accessories being furnished.

D. Interruption of Services: Construction Work shall accommodate University's use of surrounding and adjacent premises during the construction period and shall provide continuous public access and use of surrounding and adjacent facilities. Contractor shall not deny access to public use facilities until an alternate means of public use has been provided. An interruption of service is defined as any event which in any way interrupts, disrupts or otherwise discontinues, even momentarily, the services provided by University to its patients and staff. Adequate notice, as described below, shall be given to University when any interruption of services or interference with the use of existing buildings and roads are anticipated. Any interruption of service will be made only by University upon such notice. Interruptions to University services will not be made without prior notification
and approval by University. Contractor shall never interrupt any University service without direct University participation.

1. Dig Notification: Contractor shall complete and submit for review to University's Representative, a Dig Notification Form, included at the end of this section, and obtain written authorization from University prior to the commencement of any digging activities. Digging activities include exploratory demolition, soils excavation, concrete core drilling, and saw cutting. Contractor shall include all pertinent information with the Dig Notification Form and submit with detailed work plan fourteen (14) days prior to desired digging activity.

2. Contractor shall mark locations of all known utilities on ground of dig area with marker paint.

3. Prior to commencement of digging activities, Contractor shall verify project inspector has inspected the dig site and confirmed the site marking as accurate, complete and in conformance with site utility plans.

4. Contractor shall verify with University's Representative that all interested hospital departments have been notified of intent to begin digging operation.

5. Record documents are required for dig activities. Contractor shall provide as-built drawings.

E. Shutdown Procedures: Contractor shall complete and submit for review and approval to University a Request for Shutdown form, included at the end of this section. Contractor shall include all pertinent information to assist University in coordination of shutdown activities. The Shutdown Request Form shall be submitted with a detailed work plan addressing the proposed shutdown not less than fourteen (14) calendar days prior to desired shutdown.

F. The University does not normally charge for its shutdown support services. However, if poor planning and/or poor execution of a shutdown by the Contractor causes excessive time and effort for University personnel, University reserves right to deduct these costs from the Contract total.

1. Contractor shall verify with University's Fire Marshal that all appropriate Interim Life Safety Measures (ILSM) are in place.

2. Contractor shall determine that proper and appropriate coordination and notification has been completed, including written authorization from University's Representative, prior to shutdown.

3. Service shutdowns shall require specific work plans to be submitted to and coordinated with University's Representative. Work Plan should reflect various work trades, activities or entities requiring active participation with University teams to coordinating hospital functions with construction activities.

   a. Contractor shall request, schedule, and conduct a General Work Plan Meeting prior to any work activity occurrence. During this meeting Contractor and University shall produce and agree to a list of work activities, which will require digging and/or shutdown coordination and procedures.

   b. University's Representative, upon receiving the agreed submission for
coordination, shall schedule the actual digging and/or shutdown at the earliest possible date not later than fourteen (14) days from receipt of the submission. Operation of valves, switches, etc. to affect shutdowns shall be operated by University personnel only.

c. A shutdown is defined as any interruption of services provided by University to its patients and staff.

4. Planned service shutdowns shall be accomplished during periods of minimum usage. Contractor shall plan work to restore service in minimum possible time, and shall cooperate with University to reduce number of shutdowns.

a. Notwithstanding the provisions of Article 14.6 of the General Conditions of the Contract, Contractor may be required to perform certain types of work outside normal time periods.

1) Non-normal times shall include, but not be limited to, periods of time before 7:00 AM and after 5:00 PM in the evening, weekend days, or legal holidays, or such periods of time which constitute split shifts or split working periods.

2) Contractor shall include allocation of the cost of this work as part of the base bid and shall not be entitled to additional compensation as a result of such work during non-normal time periods.

3) Contractor shall include the non-normal periods as distinct activities on the detailed project schedule.

4) Contractor is advised and Contractor shall be prepared, at University written request, to perform certain shutdown and asbestos related work during non-normal time periods.

G. Utility locations: General location of utility lines and services may be shown on the drawings or described elsewhere, University does not warrant the accuracy of the locations shown or described. Determination of the actual on-site locations of utility lines and services prior to the commencement of work shall be the responsibility of the Contractor. Contractor shall complete layout/research for Points of Connection (P.O.C.) and clean/prep piping at P.O.C. All capping, relocation or removal of such lines and services shall be performed by Contractor as a part of the Contract. New/continued piping and services installation shall be prefabricated and in place prior to the shutdown. All materials and tools required to complete the work must be at the shutdown location(s). Contractor shall not assume existing valves will hold 100%. Contractor is required to have at least one (1) alternate method (including parts and equipment) to complete installation once shutdown has started. Note: only wheel type cutters shall be used on copper pipe to reduce contamination to existing systems/valves.

H. Detailed Work Plans: Contractor shall develop and submit for review and approval to University's Representative detailed work plans for specific work activities, both inside and outside the work area, associated with impact to, or interruption of services and operation, and dig activities. Work Plans shall include written description of work activity, detailed schedule with proposed sequence of operation and activity duration, type of equipment to be used, a copy of site plan highlighted to indicate sequencing and location of work and equipment, completed Request for Shutdown and/or Dig Notification forms as applicable, conformance to ILSM, and control methods for noise, vibration and
airborne contaminants.

1. Work Plan submittal will not be accepted unless all required information is provided at time of submittal.

2. Submit Work Plan at least fourteen (14) calendar days prior to the commencement of any associated work activities.

3. Coordination/Engineering Drawings: These drawings are for the Contractor's and University's use during construction and shall not be construed as replacing any shop drawings, "as-builts", or record drawings required elsewhere in the Contract Documents. University's review of these drawings is for design intent only and shall not relieve the Contractor of the responsibility for coordination of all work performed per the requirements of the Contract.
   
a. Contractor shall prepare and submit complete ¼" = 1' - 0" coordination drawings, including plans, sections, details as are appropriate indicating the area layout, complete with debris removal area and materials access points, and all mechanical and electrical equipment in all areas and within ceiling spaces for new and existing conditions, including bottom of all duct, plenum, pipe and conduit elevations. Drawings shall show all structural and architectural restraints and other obstructions that may effect the work. Electronic or photo reproduction of University's Architectural Drawings is not acceptable.

b. Each Subcontractor shall ensure all relevant mechanical and electrical equipment, piping, conduit, ceiling hangers, etc., are shown and will fit, together with necessary items such as lights, ducts, fans, pumps, piping, conduit and the like.

c. Submit completed and fully coordinated drawings together with six (6) prints together with Contractor's comments indicating possible areas of conflict for review to University's Representative prior to start of work.

d. Penetrations: Contractor shall prepare a sleeving layout (¼" scale) indicating size and locations of sleeves. Trades shall indicate to Contractor their requirements and locations. Provide copies to applicable trades and University's Representative.

e. Completion of work: All coordination drawings shall be submitted together with record (as built) drawings of all trades involved in accordance with Section 01 33 00 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

PART II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION – Not Applicable to this Section

END OF SECTION 01 31 00
REQUEST FOR SHUTDOWN (RFS) INFO/IMPACT REPORT

PROJECT NAME: Decommission North / South Wing

A/C #: M030667 OSHPD #: I140010-34-04 CONTRACTOR RFS #:

TODAY'S DATE: SHUTDOWN DATE: SUSPEND DATE:

TO: UC DAVIS HEALTH SYSTEM FROM:
Facilities Design & Construction
4800 2nd Avenue, Suite 3010
Sacramento, CA 95817
P: 916-734-7024
F: 916-734-7751
dcbrooks@ucdavis.edu Attention: Dave Brooks

Request Date: Shutdown Target Date: Requested By: Requestor’s Phone #:

Shutdown Work (Utility Specific):

Scope (Brief Description of Work):

Impact (Areas & Users):

Additional Comments:
DIG NOTIFICATION FORM

TO: UC DAVIS HEALTH SYSTEM
   Facilities Design & Construction
   4800 2nd Avenue, Suite 3010
   Sacramento, CA 95817
   P: 916-734-7024
   F: 916-734-7751
   dcbrooks@ucdmc.edu
   Attention: Dave Brooks

FROM:

1. Has USA been notified? YES NO
   When? _______________________________

2. Are all known utilities marked? YES NO

3. Location of dig shown on attached site plan? YES NO
   Purpose ________________________________

4. Dates digging will take place ________________________________
   Place ________________________________
   Signed: ________________________________

UNIVERSITY USE ONLY

Date received: ________________________________

1. Utilities verified by IOR? YES NO
2. Dig activities coordinated with all parties? YES NO
3. Comments:
   Date Authorized: ________________________________ Signed: ________________
   Date Returned: ________________________________ Signed: ________________

Comments: (Utilities encountered, disruptions, successes, weather, etc.)

Copies: UCDMC Consultants File
SECTION 01 31 15

ADDITIONAL REQUIREMENTS FOR OSHPD REVIEWED PROJECTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Additional requirements for projects under review by the California Office of Statewide Health Planning and Development (OSHPD). These requirements apply to all Prime Contractors.

B. Deferred Approvals.

1.2 RELATED SECTIONS

A. Section 01 40 00 – Quality Requirements: Testing and Inspection.

B. Section 01 70 00 – Execution and Closeout Requirements: Project closeout requirements.

1.3 REFERENCES

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only. Refer to Section 01 42 00 for definitions, acronyms, and abbreviations.

B. Unless otherwise noted, standards, manuals, and codes refer to the latest edition of such standards, manuals, and codes as of the date of issue of this Project Manual.

C. California Code of Regulations (CCR).
   1. Title 8, Division 1, Chapter 3.2 – California Occupational Safety and Health Regulations (Cal/OSHA).
   2. Title 8, Division 1, Chapter 4, Subchapter 4 – Construction Safety Orders.
   3. Title 19, Division 1 – State Fire Marshal (SFM).
      a. All Code Section numbers in this Section refer to Chapter 7 “Standards for Health Facilities”, Article 4 “Construction”.

D. Office of Statewide Health Planning and Development Website: www.oshpd.ca.gov

1.4 GENERAL REQUIREMENTS

A. Contractor Duties:
   1. Comply with Section 7-143, in addition to the duties described in the Contract Documents.
   2. Comply with Cal/OSHA.
   3. Comply with Construction Safety Orders.
   4. Comply with Regulations of SFM.
   5. Submit verified reports per Section 7-143(b) (Contractor’s Responsibilities) and 7-151 (Verified Compliance Reports).
B. Architect and Architect’s Consultants Duties: Comply with Chapter 7 of Part 1, Title 24, CCR in addition to the duties described in the Contract Documents.
   1. Administration of construction shall be per Section 7-141.

1.5 REGULATORY REQUIREMENTS

A. Perform all work in accordance with the 2013 California Building Code (CBC). A copy of Title 24, Parts 1-5, 9, and 12. Volumes 1 and 2 of the 2013 CBC (Title 24, Part 2) shall be available and kept at the project site during construction.

B. Work as described in Drawings and Specifications shall not be construed as to permit work not in accordance with applicable laws, codes, ordinances, rules, and regulations.

C. OSHPD shall be notified upon the start of construction per Section 7-137.

1.6 DEFERRED APPROVALS

A. Portions of the work have been identified in the Contract Documents as items for OSHPD Deferred Approval in accordance with Section 7-126 of Part 1, Title 24, CCR. These portions cannot be adequately detailed in Drawings because of variations in product design or manufacturer, and approval has been deferred by OSHPD pending completion of requirements.

B. Contractor shall submit the following to Architect for review and endorsement:
   1. Product information on proposed material/system supplier.
   2. Drawings, specifications, and calculations prepared, signed, and stamped by an architect or engineer licensed in the State of California for that portion of the Work.
   3. All other requirements as may be required by OSHPD.

C. The cost of preparing and submitting OSHPD Deferred Approval requirements including required modifications to Drawings and Specifications, whether or not shown in the Contract Documents, shall be borne by Contractor. Architect shall review and submit deferred approval documents to OSHPD.

D. Do not begin fabrication and installation of deferred approval items without first obtaining OSHPD approval of Drawings and Specifications.

E. Schedule of Work Subject to Deferred Approval:
   1. Fire Alarm System
   2. Fire Sprinkler System
   3. Pre-engineered access stairs and platform

1.7 ALTERATION / RECONSTRUCTION WORK

A. Per Section 7-125, the intent of Drawings and Specifications is to reconstruct the hospital building in accordance with Title 24, CCR for the alteration, rehabilitation, or reconstruction work. Should any conditions develop not covered by the Contract Documents wherein the finished work will not comply with said Title 24, CCR, a change order detailing and specifying the required work shall be submitted and approved by OSHPD before proceeding with the work.

1.8 INSPECTION AND SUPERVISION
A. The Inspector shall be approved by OSHPD. Inspector, Inspector’s duties and continuous inspection of the work shall be per Section 7-145.

1.9 TESTING LABORATORY REQUIREMENTS

A. Tests and Testing Laboratory shall be per Section 7-149.

B. Sampling and testing shall be performed by properly qualified persons in accordance with American Society for Testing and Materials (ASTM) standards.

1.10 ADDENDA AND CHANGE ORDERS

A. Comply with Section 7-153.

B. Obtain OSHPD approval for changes to code-regulated construction and inspection/testing functions prior to start of that work. Code-regulated construction refers to work that is regulated by code provisions applicable to health facility construction.

C. Do not begin any work under addendum or change order until required OSHPD written approval is obtained.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION
SECTION 01 32 00
CONTRACT SCHEDULES

PART I - GENERAL

1.1 RELATED DOCUMENTS AND SPECIFICATION SECTIONS (Not Used)

1.2 DEFINITIONS

A. Proposed contract schedule - The schedule submitted by Construction Manager as called for by this section, or any subsequent Contract Schedule submittal called for by this section shall be considered a Proposed Contract Schedule until it has been reviewed and approved by the University.

B. Contract schedule - The schedule submitted by Construction Manager representing the sole work plan for accomplishing the Work. Once the submitted Proposed Contract Schedule is reviewed and accepted by the University it shall be the baseline schedule document that forms the basis of all measurements of Contract Time in the Contract Documents. The Contract Schedule may not be modified, other than as permitted pursuant to this Section.

C. Updated progress schedule - A monthly submitted schedule reflecting current Work status of all Work Activities measured against the latest approved Contract Schedule.

D. Recovery schedule - A Proposed Contract Schedule produced by the Construction Manager once the Updated Progress Schedule forecasts that the Prime Trade Contractors will not finish the Work within the tolerances of the Contract Time called for by this section. Once the Recovery Schedule is reviewed and accepted by the University, or the University's Representative, it will be considered the Revised Contract Schedule and shall be the baseline schedule document that forms the basis of all future measurements of Contract Time, unless modified thereafter in accordance with the provisions of this Section.

E. As-built schedule – The contract schedule document maintained by the Construction Manager that records the actual work activities, durations, and interdependencies to all other Work Activities that is turned over to the University once all work is completed.

F. Float/negative float - Float for any Work Activity, will be calculated as the difference in Days between the Latest Finish Date and its Earliest Finish Date. Any calculated float which results in a "negative" number is considered Negative Float. Float is considered to be owned by the University and requires written notification for its use.

G. Constrained work activity - Shall be any earliest start or finish date; or latest start or finish date, of a Work Activity or Milestone date that is set and is not calculated in the Critical Path Method (CPM) forward or backward pass calculation. No Work Activities or Milestones on the Contract Schedule, or any other submitted schedule shall utilize Constrained Work Activities, unless expressly approved in writing by University, or the University's Representative. The only exception is that the schedule start date may be set to reflect the Notice to Proceed date.

H. Work activity - Any individual task of work shown on a schedule submitted by Prime Trade Contractor which requires time and resources (manpower, equipment, materials, etc.) to be completed in a continuous operation.

I. Milestone - An element of the schedule that reflects the planned point in time for the start, or finish, of one or more Work Activities. Milestones included in the schedule require prior
approval by the University or University’s Construction Manager.

J. Look ahead schedule - A schedule based on the Updated Progress Schedule which shows the current portion of the progress schedule or a current look ahead schedule derived from the Last Planner process. The current portion of the schedule should reflect 1 week before the data date and 5 weeks beyond the date for the schedule presented, or as reasonably requested by the University.

K. Change order fragment schedule - A schedule submitted anytime a request is issued by the Prime Trade Contractor for the adjustment in the Contract Time. A Change Order Fragment Schedule shall be based on the applicable portion of the Contract Schedule which is claimed to be impacted, necessitating an extension of the Contract Time. All modifications to the Contract Schedule Work Activities, and associated information (including duration, logic, manpower, etc.), shall be clearly identified, but the Contract Schedule information shall be left for clear comparison. Change Order Fragment Schedule shall have starting and ending Work Activities, or Milestones, from the Contract Schedule which are unchanged, (same logic constraints, duration, and resources) and shall be clearly identified.

L. Critical work activity - Work Activity, which, if delayed, will delay the scheduled completion of the Work (i.e. Work Activities which comprise the path of least total float). All other Work Activities are defined as non-critical and considered to have float.

M. Last Planner System (LPS) – The LPS requires team members to make and keep commitments based on their confidence that perquisite work, design information, materials, labor and equipment will be ready so they can start and complete installations to meet Master Schedule milestones. The Construction Manager’s Superintendent, the University and the Prime Trade Contractor Superintendents are required to participate together with all applicable trades in building a “Phase Schedule” for the each major phase of work on the project in which they will be participating. In the phase scheduling meeting, Superintendents/Foremen structure the flow of work and outline the network of commitments by identifying the hand-offs between trades. Each onsite Superintendent or lead foreman is considered a “Last Planner” in the LPS, and has the responsibility to plan their activities five (5) weeks ahead in a “Look-ahead Schedule” and to identify crew assignments for the current and next week in a “Weekly Work Plan”. Last Planners are asked to commit to performing work that they know can be made ready for their crews and to refuse to assign work they are not confident can be started and / or be completed because it is not ready.

1.3 GENERAL REQUIREMENTS

A. In collaboration with the various Prime Trade Contractors; the Construction Manager shall develop a single network plan which integrates all the activities for the Construction Manager and Prime Trade Contractors, which meet the time requirements of the Project. The sequence of all such work activities shall be determined by the Construction Manager with input on durations, sequence, and manpower from the Prime Trade Contractors. The Construction Manager shall utilize the Critical Path Method (CPM) of scheduling to develop the network logic diagrams, computer-produced schedules, and other schedule supporting data as required. When required, Prime Trade Contractors shall participate in the Last Planner System to verify Contract Schedule phasing and create Look-ahead schedules for the day to day work activities to ensure phases and milestones in the Contract Schedule are met. This will include pull planning, make ready planning, and weekly work plans from the Prime Trade Contractors. It will also
include attending University and Last Planner System meetings and check-ins as required by the Construction Manager.

B. The Prime Trade Contractors shall, within ten (10) days after the Preconstruction Conference, assemble and provide all necessary information and data concerning their activities and the activities of their subcontractors, vendors and suppliers, including durations and crew sizes, planned submission dates of required Shop Drawings, Product Data and Samples. The Prime Trade Contractor shall prepare and submit such information in the form required by Construction Manager. The resulting Construction Schedule shall constitute a representation by Prime Trade Contractor to Construction Manager, and for the benefit of other subcontractors, that the Prime Trade Contractor has the men, materials, resources, equipment and capacity to perform their work in accordance with the agreed Contract Schedule.

C. The Contract Schedule shall become a Contract Document and shall be used by the University in review of request by the Construction Manager/Prime Trade Contractor for modification of the Contract Time in accordance with the Contract Documents. Responsibility for developing the Contract Schedule and monitoring of actual progress in relation to the Contract Time, rests solely with the Construction Manager. Failure of the Construction Manager to schedule any element of the Work, or any inaccuracy in the Contract Schedule, regardless whether or not the University has reviewed and approved such schedule, will not relieve the Prime Trade Contractors of completing the Work within the Contract Time. Prime Trade Contractors assume full responsibility for the execution of the Work. The University’s review of, and response to, schedule submissions shall not be construed as relieving the Prime Trade Contractors of its complete and exclusive control over the means, methods, sequences and techniques for execution of the Work.

D. All costs for preparing, printing, mailing of any schedules called for by this section, or the Contract Documents, shall be part of the Contract Sum.

E. All requirements of the Contract Schedule shall also apply to the Proposed Contract Schedule, the Recovery Schedule, Updated Progress Schedule, Change Order Fragnet Schedule, and As-Built Schedule.

F. Acceptance of the Contract Schedule by the University, or the University’s Representative, will be a condition precedent to making any progress payment for Work performed. All Work Activities shall be of sufficient detail to provide identification of all components utilized in executing, monitoring and evaluating the progress of the Work.

G. Work Activity descriptions shall briefly delineate the scope of work identified. Work Activities shall be discrete items of Work that must be accomplished under the Contract and constitute definable, recognizable items to be performed within the Project. All Work Activities shall have defined duration. All durations shall be in multiples of working days.

H. All Work Activities shall have appropriate durations that allow measurement of their progress. In general, if a reasonable estimate of progress against a proposed Work Activity, cannot be reasonably measured, a Work Activity shall be broken into multiple Work Activities such that monitoring of actual progress versus planned progress can be ascertained. All Work Activities shall be of sufficient detail to provide identification of all components utilized in executing, monitoring and evaluating the progress of the Work.
I. Work Activities shall include all Design Work and Construction Work deliverables, including all submittals called for in the Contract: Work Activities shall include, the submittal and approval of permit applications (as necessary), samples of materials, shop drawings, working drawings, Quality Control Plan testing and inspections, safety and security plans, worksite control plans, utility point-of-connection installations and applications. In addition, Work Activities shall be included for procurement of materials and equipment potentially impacting the critical path, fabrication of special materials and equipment and their installation and testing, and delivery of University-furnished items. Work Activities of the University that may become Critical Work Activities of the Work shall be reflected, as well as Work Activities by utilities and other similarly involved third parties associated with the Work. The Contract Schedule shall include Work Activities or Milestones, but not be limited to the following: all design and pre-construction activities; specific Milestones for the start and completion for each stage of the Design Work; specific Milestone dates for requisite State and State agency information and reviews; submittal dates; production Milestones; early purchasing; key deliverables in Scope of Work; start of tenant programming (as applicable); Milestones for each Contract Phase; mobilization of personnel and equipment when required; sequence of operations; commissioning Work Activities; procurement of materials and equipment; and all contract close-out Work Activities such as Punch List period and Operation Manuals preparation and submission.

J. The Critical Work Activities shall be identified, including critical paths for Contract interim, and final completion, Milestone dates.

K. Work Activities shall be coded, at a minimum, to reflect to which Prime Trade Contractor they are associated with.

L. The Prime Trade Contractor shall not sequester float through strategies, including, but not limited to, extending Work Activity duration estimates to consume available float, using preferential logic, using extensive or insufficient crew/resource loading, use of float - suppression techniques, special lead/lag logic constraints (unless specifically requested in writing and approved by University’s Representative). Use of float time disclosed, or implied, by the use of alternate float suppression techniques shall not be for the exclusive use or benefit of either University or Prime Trade Contractor. It is acknowledged that University-caused or Prime Trade Contractor- caused time savings to Work Activities on, or near, the critical path will increase float, such increase in float shall not be for the exclusive use or benefit of either University or Prime Trade Contractor.

M. For all schedule submittals the Construction Manager shall submit both paper copy as instructed by University’s Representative and an electronic file copy containing an exact copy of paper submittal in PDF form.

PART II - PRODUCTS

2.1 SCHEDULING SOFTWARE

A. All Proposed Contract Schedules, the Recovery Schedules, Update Progress Schedules, Change Order Fragnet Schedules, and As-Built Schedules shall be prepared utilizing Primavera P6 (latest version for Windows), or equal which is 100% compatible with Primavera P6.
PART III - EXECUTION

3.1 REQUIRE SCHEDULES & SUBMITTALS

A. PROPOSED CONTRACT SCHEDULE & CONTRACT SCHEDULE

1. A Proposed Contract Schedule shall be submitted 45 days prior to required date for Construction Notice to Proceed. This Proposed Contract Schedule should incorporate any Prime Trade Contract feedback provided. Once approved by the University the Proposed Contract schedule will become the Contract Schedule and will be the basis of what Updated Progress Schedules shall be updated from each month.

2. Any time that the University requests a copy of the current schedule the Construction Manager shall have 15 days to provide the schedule requested.

B. MONTHLY STATUS REPORT/UPDATED PROGRESS SCHEDULE

1. Construction Manager shall submit an Updated Progress Schedule with status for the current month and a draft Monthly Status Report at the end of each month. The Monthly Status Report shall reflect the current status of the project, areas of concern, areas being delayed, and any other information the Construction Manager/Prime Trade Contractors feel would be helpful to the University.

C. RECOVERY SCHEDULE

1. If, at any time, it is determined by the University Representative that the progress of the Work, based on the Contract Schedule, reflects progress that would complete any critical interim and/or final Milestone dates later than 14 days called for in the Contract Documents, the Construction Manager and Prime Trader Contractors shall prepare and submit a Recovery Schedule within 15 days of notification by the University Representative. The Recovery Schedule shall address a new work plan to accomplish the Work within the Contract Time and shall include, and identify, additional concurrent operations, logic and sequence changes, additional manpower, additional shifts, or overtime work. Once reviewed and approved by the University Representative, the approved Recovery Schedule shall become the current Contract Schedule.

D. CHANGE ORDER FRAGNET SCHEDULE

1. Any time that the Construction Manager or Prime Trade Contractor requests an extension of the Contract Time, in addition to other requirements in the Contract Documents, the Construction Manager or Prime Trade Contractor shall submit a Change Order Fragnet Schedule. The Change Order Fragnet Schedule shall show any changes or delays and the logic and durations that resulted in impacts to the Contract Schedule activities. This Fragnet schedule shall be accompanied with a narrative explaining the justification of the time extension and how many work days are being requested to be added to the contract time. Failure to submit a Change Order Fragnet Schedule within the time and notice requirements specified in the Contract Documents for requesting a change to the Contract Time shall forfeit the right of the Prime Trade Contractors to an extension of the Contract Time.
E. LOOK-AHEAD SCHEDULES
   1. The Prime Trade Contractor Foremen and Superintendents shall develop Look-Ahead Schedules and weekly work plans using the Pull Planning/Reverse Phase Scheduling for phases and/or milestones in the Contract Schedule. The look ahead schedules and weekly work plans shall be statused weekly or daily as required by the Construction Manager and will be used to help update the Contract Schedule monthly. In the event the look ahead schedule do not align with the Contract Schedule the Prime Trade Contractors will be required to re-plan work to meet the Contract Schedule.
2. Look-Ahead Schedules shall be submitted at each progress meeting. It shall show all work planned for the next 5 weeks as well as what was accomplished in the week before the meeting date.
3. Look Ahead Schedules shall be reflected on a time-scale, showing planned work versus actual work completed, and shall indicate the Planned Percentage Complete (PPC) for all Work Activities completed for the previous week (or as requested by University Representative).

F. AS-BUILT SCHEDULE
   1. After Final Completion of the project the Construction manager shall submit an As-Built Schedule to the University summarizing when all activities were completed on the project. This As-Built shall be the latest version of the current Updated Progress Schedule with all activities actualized.

G. SCHEDULE UPDATING
   1. Construction Manager shall review and update the Contract Schedule once a month using information from Look Ahead Schedules. These schedule updates will be called the Updated Progress Schedule.
   2. Look-ahead Schedules/Weekly Work Plans developed by Prime Trade Contractors shall be updated once a week by Prime Trade Contractors and may require daily check-ins and re-planning efforts in order to meet project milestones. Prime Contractor personnel responsible for each work activity shall attend the check-ins and planning meetings as required by the Construction Manager. If Look-ahead schedule are not in alignment with Contract Schedule milestones Prime Trade Contractors may be required to adjust Look-ahead Schedules to meet these milestones.

H. SCHEDULE FORMAT
   1. A weather allowance activity shall be required in the Proposed Contract Schedule right before Substantial Completion and shall be the sole activity on the critical path before substantial completion. In determining the duration of the weather allowance activity, the Construction Manager shall reference the nearest weather station to the project site on https://wrcc.dri.edu and use the average rain days >=.10 inch for the year and then convert the calendar days to work days.
   2. All national holidays and major trade holidays shall be incorporated in the schedule calendars.

END OF SECTION 01 32 00
PART I - GENERAL

1.1 RELATED DOCUMENTS AND SPECIFICATION SECTIONS (Not Used)

1.2 DEFINITIONS

A. Proposed contract schedule - The schedule submitted by Construction Manager as called for by this section, or any subsequent Contract Schedule submittal called for by this section shall be considered a Proposed Contract Schedule until it has been reviewed and approved by the University.

B. Contract schedule - The schedule submitted by Construction Manager representing the sole work plan for accomplishing the Work. Once the submitted Proposed Contract Schedule is reviewed and accepted by the University it shall be the baseline schedule document that forms the basis of all measurements of Contract Time in the Contract Documents. The Contract Schedule may not be modified, other than as permitted pursuant to this Section.

C. Updated progress schedule - A monthly submitted schedule reflecting current Work status of all Work Activities measured against the latest approved Contract Schedule.

D. Recovery schedule - A Proposed Contract Schedule produced by the Construction Manager once the Updated Progress Schedule forecasts that the Prime Trade Contractors will not finish the Work within the tolerances of the Contract Time called for by this section. Once the Recovery Schedule is reviewed and accepted by the University, or the University's Representative, it will be considered the Revised Contract Schedule and shall be the baseline schedule document that forms the basis of all future measurements of Contract Time, unless modified thereafter in accordance with the provisions of this Section.

E. As-built schedule – The contract schedule document maintained by the Construction Manager that records the actual work activities, durations, and interdependencies to all other Work Activities that is turned over to the University once all work is completed.

F. Float/negative float - Float for any Work Activity, will be calculated as the difference in Days between the Latest Finish Date and its Earliest Finish Date. Any calculated float which results in a “negative” number is considered Negative Float. Float is considered to be owned by the University and requires written notification for its use.

G. Constrained work activity - Shall be any earliest start or finish date; or latest start or finish date, of a Work Activity or Milestone date that is set and is not calculated in the Critical Path Method (CPM) forward or backward pass calculation. No Work Activities or Milestones on the Contract Schedule, or any other submitted schedule shall utilize Constrained Work Activities, unless expressly approved in writing by University, or the University's Representative. The only exception is that the schedule start date may be set to reflect the Notice to Proceed date.

H. Work activity - Any individual task of work shown on a schedule submitted by Prime Trade Contractor which requires time and resources (manpower, equipment, materials, etc.) to be completed in a continuous operation.
I. **Milestone** - An element of the schedule that reflects the planned point in time for the start, or finish, of one or more Work Activities. Milestones included in the schedule require prior approval by the University or University’s Construction Manager.

J. **Look ahead schedule** - A schedule based on the Updated Progress Schedule which shows the current portion of the progress schedule or a current look ahead schedule derived from the Last Planner process. The current portion of the schedule should reflect 1 week before the data date and 5 weeks beyond the date for the schedule presented, or as reasonably requested by the University.

K. **Change order fragnet schedule** - A schedule submitted anytime a request is issued by the Prime Trade Contractor for the adjustment in the Contract Time. A Change Order Fragnet Schedule shall be based on the applicable portion of the Contract Schedule which is claimed to be impacted, necessitating an extension of the Contract Time. All modifications to the Contract Schedule Work Activities, and associated information (including duration, logic, manpower, etc.), shall be clearly identified, but the Contract Schedule information shall be left for clear comparison. Change Order Fragnet Schedule shall have starting and ending Work Activities, or Milestones, from the Contract Schedule which are unchanged, (same logic constraints, duration, and resources) and shall be clearly identified.

L. **Critical work activity** - Work Activity, which, if delayed, will delay the scheduled completion of the Work (i.e. Work Activities which comprise the path of least total float). All other Work Activities are defined as non-critical and considered to have float.

M. **Last Planner System (LPS)** – The LPS requires team members to make and keep commitments based on their confidence that perquisite work, design information, materials, labor and equipment will be ready so they can start and complete installations to meet Master Schedule milestones. The Construction Manager’s Superintendent, the University and the Prime Trade Contractor Superintendents are required to participate together with all applicable trades in building a “Phase Schedule” for the each major phase of work on the project in which they will be participating. In the phase scheduling meeting, Superintendents/Foremen structure the flow of work and outline the network of commitments by identifying the hand-offs between trades. Each onsite Superintendent or lead foreman is considered a “Last Planner” in the LPS, and has the responsibility to plan their activities five (5) weeks ahead in a “Look- ahead Schedule” and to identify crew assignments for the current and next week in a “Weekly Work Plan”. Last Planners are asked to commit to performing work that they know can be made ready for their crews and to refuse to assign work they are not confident can be started and / or be completed because it is not ready.

1.3 **GENERAL REQUIREMENTS**

A. In collaboration with the various Prime Trade Contractors; the Construction Manager shall develop a single network plan which integrates all the activities for the Construction Manager and Prime Trade Contractors, which meet the time requirements of the Project. The sequence of all such work activities shall be determined by the Construction Manager with input on durations, sequence, and manpower from the Prime Trade Contractors. The Construction Manager shall utilize the Critical Path Method (CPM) of scheduling to develop the network logic diagrams, computer-produced schedules, and other schedule supporting data as required. When required, Prime Trade Contractors shall participate in the Last Planner System to verify Contract Schedule phasing and create Look-ahead schedules for the day to day work activities to ensure phases and milestones in the Contract Schedule are met. This will include pull planning, make ready planning, and weekly work plans from
the Prime Trade Contractors. It will also include attending University and Last Planner System meetings and check-ins as required by the Construction Manager.

B. The Prime Trade Contractors shall, within ten (10) days after the Preconstruction Conference, assemble and provide all necessary information and data concerning their activities and the activities of their subcontractors, vendors and suppliers, including durations and crew sizes, planned submission dates of required Shop Drawings, Product Data and Samples. The Prime Trade Contractor shall prepare and submit such information in the form required by Construction Manager. The resulting Construction Schedule shall constitute a representation by Prime Trade Contractor to Construction Manager, and for the benefit of other subcontractors, that the Prime Trade Contractor has the men, materials, resources, equipment and capacity to perform their work in accordance with the agreed Contract Schedule.

C. The Contract Schedule shall become a Contract Document and shall be used by the University in review of request by the Construction Manager/Prime Trade Contractor for modification of the Contract Time in accordance with the Contract Documents. Responsibility for developing the Contract Schedule and monitoring of actual progress in relation to the Contract Time, rests solely with the Construction Manager. Failure of the Construction Manager to schedule any element of the Work, or any inaccuracy in the Contract Schedule, regardless whether or not the University has reviewed and approved such schedule, will not relieve the Prime Trade Contractors of completing the Work within the Contract Time. Prime Trade Contractors assume full responsibility for the execution of the Work. The University’s review of, and response to, schedule submissions shall not be construed as relieving the Prime Trade Contractors of its complete and exclusive control over the means, methods, sequences and techniques for execution of the Work.

D. All costs for preparing, printing, mailing of any schedules called for by this section, or the Contract Documents, shall be part of the Contract Sum.

E. All requirements of the Contract Schedule shall also apply to the Proposed Contract Schedule, the Recovery Schedule, Updated Progress Schedule, Change Order Fragment Schedule, and As-Built Schedule.

F. Acceptance of the Contract Schedule by the University, or the University’s Representative, will be a condition precedent to making any progress payment for Work performed. All Work Activities shall be of sufficient detail to provide identification of all components utilized in executing, monitoring and evaluating the progress of the Work.

G. Work Activity descriptions shall briefly delineate the scope of work identified. Work Activities shall be discrete items of Work that must be accomplished under the Contract and constitute definable, recognizable items to be performed within the Project. All Work Activities shall have defined duration. All durations shall be in multiples of working days.

H. All Work Activities shall have appropriate durations that allow measurement of their progress. In general, if a reasonable estimate of progress against a proposed Work Activity, cannot be reasonably measured, a Work Activity shall be broken into multiple Work Activities such that monitoring of actual progress versus planned progress can be
ascertained. All Work Activities shall be of sufficient detail to provide identification of all components utilized in executing, monitoring and evaluating the progress of the Work.

I. Work Activities shall include all Design Work and Construction Work deliverables, including all submittals called for in the Contract: Work Activities shall include, the submittal and approval of permit applications (as necessary), samples of materials, shop drawings, working drawings, Quality Control Plan testing and inspections, safety and security plans, worksite control plans, utility point-of-connection installations and applications. In addition, Work Activities shall be included for procurement of materials and equipment potentially impacting the critical path, fabrication of special materials and equipment and their installation and testing, and delivery of University-furnished items. Work Activities of the University that may become Critical Work Activities of the Work shall be reflected, as well as Work Activities by utilities and other similarly involved third parties associated with the Work. The Contract Schedule shall include Work Activities or Milestones, but not be limited to the following: all design and pre-construction activities; specific Milestones for the start and completion for each stage of the Design Work; specific Milestone dates for requisite State and State agency information and reviews; submittal dates; production Milestones; early purchasing; key deliverables in Scope of Work; start of tenant programming (as applicable); Milestones for each Contract Phase; mobilization of personnel and equipment when required; sequence of operations; commissioning Work Activities; procurement of materials and equipment; and all contract close-out Work Activities such as Punch List period and Operation Manuals preparation and submission.

J. The Critical Work Activities shall be identified, including critical paths for Contract interim, and final completion, Milestone dates.

K. Work Activities shall be coded, at a minimum, to reflect to which Prime Trade Contractor they are associated with.

L. The Prime Trade Contractor shall not sequester float through strategies, including, but not limited to, extending Work Activity duration estimates to consume available float, using preferential logic, using extensive or insufficient crew/resource loading, use of float suppression techniques, special lead/lag logic constraints (unless specifically requested in writing and approved by University’s Representative). Use of float time disclosed, or implied, by the use of alternate float suppression techniques shall not be for the exclusive use or benefit of either University or Prime Trader Contractor. It is acknowledged that University-caused or Prime Trade Contractor- caused time savings to Work Activities on, or near, the critical path will increase float, such increase in float shall not be for the exclusive use or benefit of either University or Prime Trade Contractor.

M. For all schedule submittals the Construction Manager shall submit both paper copy as instructed by University’s Representative and an electronic file copy containing an exact copy of paper submittal in PDF form.
PART II - PRODUCTS

2.1 SCHEDULING SOFTWARE

A. All Proposed Contract Schedules, the Recovery Schedules, Update Progress Schedules, Change Order Fragnet Schedules, and As-Built Schedules shall be prepared utilizing Primavera P6 (latest version for Windows), or equal which is 100% compatible with Primavera P6.

PART III - EXECUTION

3.1 REQUIRE SCHEDULES & SUBMITTALS

A. PROPOSED CONTRACT SCHEDULE & CONTRACT SCHEDULE

1. A Proposed Contract Schedule shall be submitted 45 days prior to required date for Construction Notice to Proceed. This Proposed Contract Schedule should incorporate any Prime Trade Contract feedback provided. Once approved by the University the Proposed Contract schedule will become the Contract Schedule and will be the basis of what Updated Progress Schedules shall be updated from each month.

2. Any time that the University requests a copy of the current schedule the Construction Manager shall have 15 days to provide the schedule requested.

B. MONTHLY STATUS REPORT/UPDATED PROGRESS SCHEDULE

1. Construction Manager shall submit an Updated Progress Schedule with status for the current month and a draft Monthly Status Report at the end of each month. The Monthly Status Report shall reflect the current status of the project, areas of concern, areas being delayed, and any other information the Construction Manager/Prime Trade Contractors feel would be helpful to the University.

C. RECOVERY SCHEDULE

1. If, at any time, it is determined by the University Representative that the progress of the Work, based on the Contract Schedule, reflects progress that would complete any critical interim and/or final Milestone dates later than 14 days called for in the Contract Documents, the Construction Manager and Prime Trader Contractors shall prepare and submit a Recovery Schedule within 15 days of notification by the University Representative. The Recovery Schedule shall address a new work plan to accomplish the Work within the Contract Time and shall include, and identify, additional concurrent operations, logic and sequence changes, additional manpower, additional shifts, or overtime work. Once reviewed and approved by the University Representative, the approved Recovery Schedule shall become the current Contract Schedule.

D. CHANGE ORDER FRAGNET SCHEDULE
1. Any time that the Construction Manager or Prime Trade Contractor requests an extension of the Contract Time, in addition to other requirements in the Contract Documents, the Construction Manager or Prime Trade Contractor shall submit a Change Order Fragnet Schedule. The Change Order Fragnet Schedule shall show any changes or delays and the logic and durations that resulted in impacts to the Contract Schedule activities. This Fragnet schedule shall be accompanied with a narrative explaining the justification of the time extension and how many work days are being requested to be added to the contract time. Failure to submit a Change Order Fragnet Schedule within the time and notice requirements specified in the Contract Documents for requesting a change to the Contract Time shall forfeit the right of the Prime Trade Contractors to an extension of the Contract Time.

E. LOOK-AHEAD SCHEDULES

1. The Prime Trade Contractor Foremen and Superintendents shall develop Look-Ahead Schedules and weekly work plans using the Pull Planning/Reverse Phase Scheduling for phases and/or milestones in the Contract Schedule. The look ahead schedules and weekly work plans shall be statused weekly or daily as required by the Construction Manager and will be used to help update the Contract Schedule monthly. In the event the look ahead schedule do not align with the Contract Schedule the Prime Trade Contractors will be required to re-plan work to meet the Contract Schedule.

2. Look-Ahead Schedules shall be submitted at each progress meeting. It shall show all work planned for the next 5 weeks as well as what was accomplished in the week before the meeting date.

3. Look Ahead Schedules shall be reflected on a time-scale, showing planned work versus actual work completed, and shall indicate the Planned Percentage Complete (PPC) for all Work Activities completed for the previous week (or as requested by University Representative).

F. AS-BUILT SCHEDULE

1. After Final Completion of the project the Construction manager shall submit an As-Built Schedule to the University summarizing when all activities were completed on the project. This As-Built shall be the latest version of the current Updated Progress Schedule with all activities actualized.

G. SCHEDULE UPDATING

1. Construction Manager shall review and update the Contract Schedule once a month using information from Look Ahead Schedules. These schedule updates will be called the Updated Progress Schedule.

2. Look-ahead Schedules/Weekly Work Plans developed by Prime Trade Contractors shall be updated once a week by Prime Trade Contractors and may require daily check-ins and re-planning efforts in order to meet project milestones. Prime Contractor
personnel responsible for each work activity shall attend the check-ins and planning meetings as required by the Construction Manager. If Look-ahead schedules are not in alignment with Contract Schedule milestones, Prime Trade Contractors may be required to adjust Look-ahead Schedules to meet these milestones.

H. SCHEDULE FORMAT

1. A weather allowance activity shall be required in the Proposed Contract Schedule right before Substantial Completion and shall be the sole activity on the critical path before substantial completion. In determining the duration of the weather allowance activity, the Construction Manager shall reference the nearest weather station to the project site on https://wrcc.dri.edu and use the average rain days >= .10 inch for the year and then convert the calendar days to work days.

2. All national holidays and major trade holidays shall be incorporated in the schedule calendars.

END OF SECTION 01 32 16
SECTION 01 33 23
SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Administrative requirements for shop drawings, product data and samples submittals
B. University's and University's Consultant's review of submittals
C. Contractor's review of submittals
D. Shop Drawing Submittals
E. Product Data submittals
F. Sample submittals
G. Submittal Schedule requirements

1.2 RELATED SECTIONS

A. Section 01 11 00 – SUMMARY OF THE WORK: Subcontractor and materials suppliers list.
B. Section 01 32 00 – CONTRACT SCHEDULES: Submission and review of schedules and submittals.
C. Section 01 45 00 – QUALITY CONTROL: Test and Inspection Reports.
D. Section 01 77 00 – CLOSEOUT PROCEDURES: Occupancy/Acceptance /Final Payment Submittals.
E. Section 01 78 00 – CLOSEOUT SUBMITTALS: Preparation of Maintenance and Operating Data.

1.3 ADMINISTRATIVE REQUIREMENTS

A. General Submittals Review: Submittals shall be made in accordance with requirements specified herein and in individual Sections.

1. Submittals shall be a communication aid between Contractor, University’s Representative, and University’s Consultant(s) by which interpretation of Contract Documents requirements may be confirmed in advance of construction.

2. Submit on all products to be used on the Project. Make all submittals through the University unless otherwise directed.

   a. The University’s Representative shall provide timely review of submittals and re-submittals.
1) University's Representative shall have fourteen (14) calendar days from receipt to review all submittals and fourteen (14) calendar days from receipt to review re-submittals.

2) University’s Representative will prepare and keep a log of review time of all submittals.

3. Substitutions shall be submitted in accordance with Section 01 60 00 – PRODUCT REQUIREMENTS.

4. Make submittals sufficiently in advance of construction activities to allow shipping, handling and review by the University's Representative and their consultants.

B. University's and University's Consultants Review: University's Consultant's review will be only for general conformance with the design intent of the Contract Documents. Review of submittals is not conducted for purpose of determining 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 the Contractor as required by the Contract Documents. Review actions of the University's Consultant or University shall not relieve Contractor from compliance with requirements of the Contract Documents. Changes shall only be authorized by separate written Change Order in accordance with the General Conditions of the Contract.

C. Contractors Review: Contractor shall review, mark-up as appropriate and stamp Shop Drawings, Product Data, and Samples prior to submission. Submittal shall clearly show it has been reviewed by Contractor for conformance with the Contract Documents and for coordination with requirements of the Work. Notify University's Representative in writing, at time of submission, of any changes in the submittals from requirements of Contract Documents.

1.4 SUBMITTAL REQUIREMENTS

A. Prompt Submission: Submittals shall be submitted promptly in accordance with Submittal Schedule and in such sequence as to cause no delay in the Work or in the work of any separate contractor. Present information in a clear and thorough manner to aid orderly review.

B. Preparation: Title each submittal with Project name and A/C number, submittal date and dates of any previous submissions. Clearly mark each copy to identify product or model.

1. Identify each item on submittal by reference to Drawing sheet number, detail, schedule, room number, assembly or equipment number, Specification number Reference Standard (such as ASTM or Fed Spec Number) and other pertinent information to clearly correlate submittal with Contract Documents.

2. Include the names of the Contractor, Subcontractor, Supplier and Manufacturer.

3. Include field dimensions, clearly identified as such to establish relationship to adjacent or critical features of the Work or materials.

4. Include pertinent information such as performance characteristics and capacities, wiring or piping diagrams and controls, catalog numbers and similar data.
5. Modify manufacturer’s standard schematic drawings and diagrams and other diagrams to delete information not applicable to the Work. Supplement standard information to provide information specifically applicable to the Work.

6. Identify changes from requirements of the Contract Documents.

7. Include 8” x 3” blank space on face of submittal for review stamps.

8. Include Contractor’s review stamp, initialed or signed, and dated, certifying to the review of the submittal, verification of materials, field measurements, conditions, and compliance of the information within the submittal with the requirements of the Work and of the Contract Documents.

C. Number of submittals required:

1. Product Data and Non-reproducible Submittals: Upload submittals electronically to the University Representative’s web-based platform. Provide up to 8 hard copies if requested by the University Representative.

2. Initial/Re-submitted Shop Drawing Review(s): Upload submittals electronically to the University Representative’s web-based platform. Provide up to 8 hard copies if requested by the University Representative.

3. Samples: Submit number specified. Create transmittal within the University Representative’s web-based platform for submittal tracking and comments. Samples shall be of sufficient size and quality to clearly illustrate the functional characteristics of the products, with integrally related parts and attachment devices, including full range of colors, textures and patterns.

D. Identifying Submittals: Identify each submittal by Specification section number followed by a number indicating sequential submittal for that Section. Re-submittals shall use the same number as the original submittal, followed by a letter indicating sequential re-submittal. Examples:

1. 09250 – 1: First submittal for Section 09250 – Gypsum Board
2. 09250 – 2: Second submittal for Section 09250 – Gypsum Board
3. 09250 – 2A: Re-submittal of second submittal for Section 09250 – Gypsum Board
4. 09250 – 2B: Second re-submittal of 2nd submittal for Section 09250 – Gypsum Board

E. Resubmission Requirements: Revise and resubmit as specified for initial submittal. Identify any Changes other than those requested. Note any departures from Contract Documents or changes in previously reviewed submittals.
F. Grouping of Submittals: Unless otherwise specifically permitted by University's Representative, make all submittals in groups containing all associated items as described in each Specification Section. The University's Representative will reject partial submittals as incomplete.

G. Unsolicited Submittals: Unsolicited submittals will be returned NOT REVIEWED.

1.5 DISTRIBUTION

A. Reproduce and distribute finalized copies of Shop Drawings and Product Data, to the following:

1. Contractor's Project site file.
2. Record Documents file maintained by Contractor.
3. Pertinent Separate Contractors.
4. Pertinent Subcontractors.
5. Pertinent Supplier or Manufacturer.

1.6 SUBMITTAL SCHEDULE

A. Submittals Schedule: refer to Section 01 32 00 – CONTRACT SCHEDULES.

1. The Submittal Schedule is a schedule for submission of Shop Drawings, Product Data and Samples by Contractor, and the processing and return of same by University.

2. Contractor shall prepare the Submittal Schedule as described herein and coordinate it with the Contract Schedule. No submittals will be processed before the Submittal Schedule has been submitted to and accepted by University.

3. Submittal Schedule shall be adjusted to meet needs of construction process and the Contract Schedule. Submit two (2) copies of the Submittal Schedule after it is completed and each time it is update by Contractor.

4. Contractor shall NOT begin fabrication or Work which requires submittals until the return of final reviewed and approved submittals have been received by the Contractor.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 33 23
PART I - GENERAL

1.01 SECTION INCLUDES

A. Interim Life Safety Measures (ILSM)
B. Security Procedures
C. Hazardous Materials Procedures

1.02 RELATED SECTIONS

A. General Conditions of the Contract
B. Section 01 11 00 – SUMMARY OF THE WORK
C. Section 01 31 00 – COORDINATION
D. Section 01 32 00 – CONTRACT SCHEDULES
E. Section 01 56 00 – TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS
F. Section 01 56 01 – AIRBORNE CONTAMINANTS CONTROL
G. Section 01 73 00 – CUTTING AND PATCHING
H. Section 01 74 00 – CLEANING

1.03 INTERIM LIFE SAFETY MEASURES (ILSM)

A. ILSM Definition: Interim Life Safety Measures are those activities that are undertaken during construction, repair, and improvement operations that are established to temporarily compensate for the deficiencies caused in fire safety and protection that may be associated with such projects.

B. Quality Assurance: Interim Life Safety Measures (ILSM) program shall comply with The Joint Commission Standards, Life Safety (LS) Section, LS.01.02.01.

1. Contractor shall be responsible for setting up control procedures to adhere to ILSM Criteria Implementation Matrix and/or the ILSM Inclusion Criteria. Contractors shall notify University's Representative of anticipated and actual problems complying with ILSM.

2. Contractor shall submit proposed Fire and Life safety impairments (21) days prior to implementation. Submittal of ILSM does not infer or guarantee acceptance by University. All submitted measures shall be reviewed and returned to Contractor indicating approval, approval as noted, or rejection, revision, or re-submittal requirement by University in writing no less than fourteen (15) calendar days prior to proposed implementation. If re-submittal is required, twenty-one (21) day review period from date of re-submittal, will be required.
C. Project ILSM Procedures: If a life safety code deficiency occurs, or is identified by any source, or the requirements of the current Life Safety Code are not being met; Interim Life Safety Measures must be implemented to the extent necessary to compensate for any deficient element(s) predicated on magnitude, severity, extent and duration before corrective actions are completed.

Any minor life safety code deficiency that could be corrected within 45 days that is confined to a single smoke compartment or fire zone will not merit for declaring a hospital-wide ILSM(s) but would require reduction in flammable and combustible loads in the affected smoke compartment or zone as well as issuing a work order to complete the Plan For Improvement (PFI) within 45 days of discovery.

The ILSM Criteria Implementation Matrix and/or the ILSM Inclusion Criteria forms completed by a University Representative are used to determine when and to what extent applicable ILSM measures as it pertains to each condition is required to be implemented. Based on the ILSM Inclusion Criteria assessment form, it may not be necessary to declare the need to implement ILSM measures under certain conditions as delineated in the form. When ILSMs are determined to be required, an ILSM Implementation Matrix shall be utilized by the contractor.

ILSMs must be implemented upon project development and must be continuously enforced through project completion. A comprehensive plan of correction is to be developed by the Project Representative, or designee using the ILSM Evaluation Form.

D. Any impairment or shutdown of a passive or active fire and life safety device/system for a period of 4 hours or longer in a 24 hour period will require implementation of an ILSM. Some of the most common impairments are outlined below. The listing of these ILSM examples is not intended to limit or preclude preventative actions that may be required to temporarily compensate for other life safety deficiencies that may arise during construction activities due to unforeseen conditions, the contractor's changing work plan, or required continuing activities of University. Comments following each ILSM are known ILSM requirements at time of bid. These comments are made to assist Contractor in bid preparation and later preparation of ILSM plan for the Project. University makes no guarantee these comments address all conditions requiring action by Contractor.

1. **ILSM #1:** Ensure exits provide free and unobstructed egress. Maintain free and unobstructed access and exits from all buildings to public ways. Maintain escape facilities for construction workers at all times. Inspect means of egress in construction areas daily. Alternate means of egress are to be in place prior to abandonment of existing means of egress and must be accepted by University prior to time of abandonment of existing. Notify University's Representative of schedule for switchover. Allow University one (1) week to train staff after creating alternate means of egress and before abandoning existing means of egress.

   Description of alternate exiting: [Contractor to submit description and drawings for this project] **EXAMPLE:**

   *ALL FLOORS: North Alternate Exit - Abandoned ER main entry and Stair #7, East Alternate Exit - Stair #1 and 1st Floor Corridor 1418 & West Alternate Exit - Lobby 1003 and the adjacent multi-level emergency ramps:* Phase work as required to continuously provide exit routes at north, east, and west sides of each building at all times. See attached plans showing egress routes and gathering area. Egress plan will be clearly posted at all exits.

   **OR EXAMPLE:**
ALL FLOORS: Access will be maintained from existing connecting links between East Wing, and North/South Wing & University Tower. Attached plans show egress routes and gathering area. Egress plan will be clearly posted at all exits.

ILSM #2: Maintain free & unobstructed access to emergency departments/services.
Description of intended action: [Contractor to submit description and drawings for this project]

EXAMPLE: Provide and maintain emergency access for existing fire lane at the east side of Electrical Room 1004. Phase utility work in roadways and sidewalks as necessary to maintain constant access at all existing fire lanes, standpipes, hydrants, and building entrances. See attached plans showing access routes, standpipes, hydrants and building entries.

AND/OR EXAMPLE: Provide personnel during working hours to direct traffic and control construction activities impacting movement of emergency vehicles, University staff and patients. Cease construction activities as necessary to ensure safe patient transport and transfer. See attached plans showing access routes.

2. ILSM #3: Ensure fire alarm, detection, and suppression systems are not impaired. Provide temporary equivalent system when any fire system is impaired. Inspect and test temporary systems monthly.
   a. Extend or reduce existing fire alarm, detection, and suppression systems as required throughout construction to maintain coverage for existing areas.

Description of intended action: [submit description and drawings for this project]

EXAMPLE: After the removal of the acoustical ceiling, rotate sprinkler heads upright, and confirm all existing Fire Alarm devices are functioning within all areas under construction. See attached plans showing locations of upright sprinkler heads and Fire Alarm devices.

b. Refer to Section 01 50 00 – TEMPORARY UTILITIES - Temporary Fire Protection, for additional requirements to be included in ILSM #3.

3. ILSM #4: Ensure temporary construction partitions are smoke tight and built of noncombustible or limit combustible material that will not contribute to the development or spread of fire.
   a. Temporary construction partitions shall be built of permanent materials similar to adjacent construction and shall carry the same fire ratings as adjacent construction or as required to suit the situation. Fire retardant plastic or canvas tarps will not be utilized in temporary construction partitions unless approved by University Fire Marshal.

Description of intended action: [submit description and drawings for this project]
b. **EXAMPLE:** Temporary 2 hour partitions with 90 minute fire rated doors & hardware will be installed at 3 locations, and a 1 hour partition will be installed at 1 location. Construction of 2 hour partitions and doors will match existing. Construction of 1 hour partition per 5/A-531. Schlage hardware cylinders to be blank “EF” keyways. “Walk-off” mats will be provided at each side of the door openings and maintained per Division 01 requirements. See attached plans for locations of rated partitions and secured door openings.

4. Refer to Section 01 56 00 – TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS, for additional requirements to be included in ILSM #4.

5. ILSM example #5: Provide additional firefighting equipment and use training for construction workers.

6. ILSM example #6: No smoking. Contractor shall follow the Universities smoking policy.

7. ILSM example #7: Develop and enforce storage, housekeeping, and debris removal practices that reduce the flammable and combustible fire load of the building to the lowest level necessary for daily operations.

8. ILSM example #8: Conduct a minimum of two (2) fire drills per shift per quarter.

9. ILSM example #9: Conduct regular hazard surveillance of buildings, grounds, and equipment with special attention to excavations, construction areas, construction storage, and field office.

10. ILSM example #10: Train personnel when structural or compartmentalization features compromise fire safety measures.

11. ILSM example #11: Conduct organization-wide safety education programs to ensure awareness of any LSC (Life Safety Control) deficiencies, construction hazards, and ILSM.

### 1.04 SECURITY PROCEDURES

A. Security Program: Protect Work, existing premises, and University operations from theft, vandalism, and unauthorized entry.

1. Security of the area shall be strictly maintained. Contractor shall control entrance of persons and vehicles related to University operations.

B. Entry Control: Restrict entry of persons and vehicles into Project site and existing facilities. Allow entrance only to authorized persons with proper identification. Maintain log of workers and visitors, make available to University's Representative.

1. Contractor shall control entrance of persons and vehicles related to University operations.

C. Personnel Identification: Provide identification card to each person authorized to enter premises, showing: Personal photograph, name and assigned number, expiration date, and employer. Maintain a list of accredited persons; submit copy to University's Representative on request.
D. Miscellaneous Restrictions: Do not allow cameras on site; do not allow photographs except with written approval of University.

1.05 HAZARDOUS MATERIALS PROCEDURES

A. Except as otherwise specified, should Contractor encounter site materials, reasonably believed to be asbestos, polychlorinated biphenyl (PCB), radioactive material, lead in paint, lead lining in walls or glass windows, lead in ceramic products, mold, water leaks or other hazardous materials or conditions, the Contractor shall immediately stop work in the affected area and report the condition to University's Representative in writing. The work in the affected area shall not thereafter be resumed except by written agreement of University and Contractor if in fact the material is identified as hazardous and has not been rendered harmless. The work in the affected area shall be resumed in the absence of hazardous materials, or when such materials have been rendered harmless.

B. Spills, discharges, overruns, or similar occurrences involving hazardous materials on site shall be promptly reported in writing to University's Representative. If Contractor fails to notify University in a prompt and timely manner of an occurrence, University will contract with licensed hazardous materials abatement contractor to clean up the hazardous material. Contractor shall pay all costs of removal, including financial penalties incurred, the result of the Contractor's failure to act promptly in response to the product emergency.

C. Contractor shall provide means and personnel to contain and control product emergencies, or shall provide means and methods to render hazardous materials harmless.

PART II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION – Not Applicable to this Section

END OF SECTION 01 35 00
# ILSM SURVEILLANCE SURVEY

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Inspector Name (print) ____________________________  Signature ____________________________

01 35 00 - 6
SPECIAL PROCEDURES
01/10 Edition; Rev. 0
UCDMC FIRE DRILL REPORT

Date: _______________ Quarter: 1st 2nd 3rd 4th Shift: Day Swing Night
Location: _______________________ Department: _______________________
Drill Scenario: ______________________________________________________

Time of fire discovery: ________________
How was RESCUE performed: _________________________________________

How did personnel respond to CONFINE the fire: _________________________

Time of CODE RED announcement: __________
Time FIRE EXTINGUISHER was brought to fire scene: ________________
Time PO&M arrived: ________________
Time UCD Police arrived: _______________
Time Patient Escort arrived: _______________
Type of extinguisher used: Class A Class B:C Class A:B:C.

Did staff check all corridor fire doors to be sure they closed and latched properly? Yes No.
Did staff clear all miscellaneous items from all corridors? Yes No.
Did staff know location of Horizontal Exits and areas of Refuge? Yes No.

Participants: (Please Print)

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Use the Back of this form for Comments / Observations:

Evaluator's Signature: ________________________
UCDMC FIRE DRILL REPORT (continued)

Review evaluation form with nursing staff:
Discuss impact to adjacent areas.
Discuss why it is necessary to clear corridors.

How did staff react to the Code Red?

Discuss process for notification of Fire Department, in case of fire:
Discuss where the 911 phone call goes and involvement of the UCD dispatchers, specifically trained for UCDMC and Campus needs.
Discuss dispatcher responsibilities:
1). Relays call to Sacramento Fire Department while caller stays on line.
2). Call to hospital Operator, notification of PO&M and announcement over hospital paging system.
3). Contacts UCDMC Police Department via radio.
4). Contacts UCDMC Fire Department representative.

Discuss fire safety features in hospital:
Location of 2 hour fire doors and walls.
Location of fire rated corridors.
Fire alarm system components.
Whether or not area has fire sprinklers.
Location and type of fire extinguishers.

Discuss main causes of false alarms: (Dirty smoke detectors, popcorn fumes, burnt toast, etc.).
Project Title: ___________________________ Date: ________________

Project No.: ___________________________ OSHPD No.: ________________

Project Description:
__________________________________________________________________________
__________________________________________________________________________

1. Are any exit doors, exit corridors or stairwells affected at any time as a result of this project?
   ____ YES  ____ NO

   If yes, provide a floor plan showing how exiting is affected. Temporary exit signs and/or evacuation signs may be required.

2. Is access to fire and life safety emergency equipment or services affected as part of this project?
   ____ YES  ____ NO

   If yes, what equipment or services: ____________________________
                                           ____________________________
                                           ____________________________

3. Will any fire protection system (fire alarms, smoke detectors, fire sprinklers, fire extinguishers, telephones, overhead paging, etc.) be impaired as part of this project?
   ____ YES  ____ NO

   If yes, a temporary but equivalent system must be in place to provide equal protection.

4. Will any fire/smoke rated walls or doors be affected as part of this project?
   ____ YES  ____ NO

   If yes, a temporary partition with the same fire/smoke rating as the affected wall or door must be in place to provide equal protection. Provide a floor plan showing the location of temporary walls/doors.

5. All but the most minor construction projects must be separated from all occupied portions of the building, including all exit ways, by not less than a one hour construction barriers. Are construction barriers required as part of this project?
   ____ YES  ____ NO

ILSM IMPACT WORK SHEET (continued)
If yes, provide a floor plan showing the exact location of all construction barriers. Include the location of doorways to/from the construction area.

6. Additional firefighting equipment: ____________________________________________
   ____________________________________________
   ____________________________________________

7. Smoking is not allowed on any job site or in any UCDMC owned, occupied or leased facility. Copy of NO SMOKING policy provided to:
   (Name) ____________________________________________ (Date) ___________

8. Maintain areas under the contractors control in a clean and orderly condition free of waste materials, debris, and rubbish. Copy of specification section regarding construction cleaning provided to:
   (Name) ____________________________________________ (Date) ___________

9. Are fire drills required as part of this project?
   ___ YES   ___ NO

   If yes, list the areas where the fire drills will be conducted:
   ____________________________________________
   ____________________________________________
   ____________________________________________

10. Hospital personnel and contractors must receive ILSM fire safety training when Exiting or fire alarm systems are affected. Is ILSM fire safety training required as part of this project?
    ___ YES   ___ NO

    If yes, list the areas where training will be conducted:
    ____________________________________________
    ____________________________________________
    ____________________________________________

11. Documentation - When ILSM’s are required the following documentation must be maintained:
    a. Training rosters.
    b. Fire drill reports.
    c. Monthly inspection and testing of temporary fire alarm, detection, and suppression systems.
    d. Daily inspection of construction area.
    e. Weekly inspection of Buildings, grounds and equipment with special attention to excavations, construction areas, construction storage, and field offices.
SECTION 01 35 29
CONTRACTOR(S) EMERGENCY PROCEDURES

PART 1 - GENERAL

1.1 The purpose of this specification is to outline, to the Contractor, the University’s policy and procedures for effective project site management of an emergency situation during the construction of projects at the UC Davis Medical Center.

1.2 This procedure applies to all Contractors and their subcontractors who have contractual agreements with the UC Davis Medical Center.

PART 2 - DEFINITIONS

2.1 Disaster – any natural or human-made event that causes major disruption such as damage to the organization’s buildings or grounds from severe weather conditions, earthquakes, other natural phenomena or loss of utilities (power, water and telephones), acts of civil disobedience, accidents or emergencies within the organization or in the surrounding community.

2.2 Code Green – a code notifying all employees that an emergency event (internal or external) has occurred and UCDHS operations will be immediately shifting to its emergency management mode. The terminology for a disaster occurring outside the Main Hospital facility is CODE GREEN – EXTERNAL, and for an incident occurring within, CODE GREEN – INTERNAL.

2.3 Code Green Alert – there will be times when UCDHS will have the opportunity to ready itself in advance of an emergency event (e.g., floods, work stoppage/strike, etc.). The Director (or designee) will place the hospital on a CODE GREEN – ALERT. During this alert status, departments will make immediate assessment of their on-site resources and prepare to augment those resources to ensure adequate levels of support are available.

2.4 Code Red – Fire

2.5 Code White – Hazardous Material / Chemical Spill

2.6 Control Facility – the County of Sacramento has designated UCDHS as the Control Facility for Sacramento County. The Control Facility coordinates medical control of patients and victims dispersal to hospitals in the community/region.

2.7 External Disasters – those disasters taking place in the community or region or in UCDHS facilities other than the Main Hospital, Trauma Nursing Unit (TNU) (Building 94) or Building 64.

2.8 Internal Disasters – those disasters taking place within the Main Hospital, TNU (Building 94) or Satellite Surgery Suite (SSS, Building 64).

2.9 Other emergency situations include the following systems failures as outlined in the UC Davis Emergency Response Plan.

A. Water system failure
B. Telephone system failure
C. Fire
D. Electrical system failure
E. Security
F. Chemical spill
G. Evacuation

PART 3 - PROCEDURES

3.1 The Contractor will be issued a UC Davis Medical Center Emergency Response Plan at the project

A. Pre-construction meeting. This plan must be posted at the project site at all times in a visible location known to all project contractors.

B. Contractor is directed to contact appropriate emergency personnel as outlined in the Emergency Response Plan information during an emergency.

C. If the emergency involves an outside utility company, Contractor is to contact utility company directly. Known outside utilities located at the UC Davis Medical Center campus are as follows.

1. Emergency Telephone Numbers
   a. SMUD (Electrical) 916-732-7119
   b. PG&E (Gas) 800-745-5000
   c. Sacramento Water District (Water) 916-264-5011

END OF SECTION 01 35 29
PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Fundamental Building Systems Commissioning
B. Construction Waste Management: Divert 80% from Landfill
C. Construction Indoor Air Quality (IAQ) Management Plan: During Construction

1.2 RELATED DOCUMENTS AND SECTIONS

A. Section 01 56 00 – Temporary Barriers, Enclosures and Controls
B. Section 01 56 10 – Airborne Contaminants Control
C. Section 01 60 00 – Product Requirements
D. Section 01 74 00 – Cleaning
E. Section 01 75 00 – Starting and Adjusting Systems
F. Section 01 76 00 – Protecting Installed Construction
G. Section 01 77 00 – Closeout Procedures
H. Section 01 78 00 – Closeout Submittals
I. Section 01 86 00 – Plumbing/HVAC Testing Procedures
J. Section 01 79 00 – Demonstration and Training
K. Division 23 – Mechanical Work (All)
L. Division 26 – Electrical Work (All)

1.3 FUNDAMENTAL BUILDING SYSTEMS COMMISSIONING

A. Commissioning is a systematic process of ensuring that all building systems and assemblies perform interactively according to University objectives and requirements and the design according to the contract documents. The commissioning process encompasses and coordinates the traditionally separate functions of system documentation, equipment start-up, control system calibration, systems testing, testing and balancing, and training. The commissioning process does not take away from or reduce the responsibility of the Contractor to provide a finished and fully functioning product. Commissioning during construction is intended to achieve the following specific objectives:

1. Ensure that applicable equipment, systems, and assemblies are installed according to the manufacturer’s recommendations and to accepted industry standards, and that they receive adequate operational checkout by the Contractor.
2. Ensure and document that equipment, systems, and assemblies function and perform according to University objectives and requirements and the Contract Documents.

3. Ensure that operations and maintenance (O&M) manuals are complete.

4. Ensure that University operating and maintenance personnel for all systems are adequately trained.

B. Commissioning will be performed under the authority and management of the University Plant Operations & Maintenance Department (PO&M), as an independent organization whose individuals are not directly responsible for project design or construction management.

C. Contractor Commissioning Responsibilities

1. Designate a Commissioning Coordinator to organize, schedule, and coordinate the execution of Contractor and subcontractor commissioning responsibilities.

2. Ensure that commissioning activities are represented in the contract schedule.

3. Notify the University when system testing for mechanical and electrical items, installations, and equipment per mechanical and electrical specifications will be conducted.

4. Provide all labor, materials, and subcontractor support required for system testing and commissioning to the University.

5. Attend and participate in commissioning planning and other associated meetings to facilitate the commissioning process.

6. Provide additional documentation prior to normal O&M manual submittals to the University for development of installation, start-up, and testing procedures.

7. Assist in clarifying the operation and control of commissioned equipment or assemblies in areas where the specifications, control drawings, or equipment documentation is not sufficient preparing testing procedures.

8. Review test procedures developed by the University to ensure feasibility, safety, and equipment protection.

9. Execute testing for selected systems and assemblies under the direction of the University.

10. Ensure that the local authorities having jurisdiction are present to witness any acceptance testing of systems that are a condition of building occupancy (fire alarm, fire damper, sprinkler system, etc.).

11. Train University personnel and prepare O&M manuals in accordance with the Contract Documents.

1.4 CONSTRUCTION WASTE MANAGEMENT: DIVERT 80% FROM LANDFILL

A. Landfill Diversion Requirement: Divert 80% minimum of total project waste from landfill.
B. Storage bins

C. Submittals

1. Waste Management Plan (WMP): Provide the following information:
   a. Waste Material Estimating Sheet (Appendix A at the end of this Section): Project title, name of company which will implement the plan, and date.
   b. Estimated job site waste to be generated, including types and quantities.
   c. Proposed Alternatives to Landfilling: List each material planned to be salvaged or recycled, including quantities and proposed destination.

2. Waste Management Progress Reports: Submit the following information to the UCDHS Sustainability Administrator on a monthly basis (information for June is due by July 20):
   a. Waste Management Log (Appendix B at the end of this Section):
   b. Project title, name of company completing report and dates of period covered by the report.
   c. Date, destination, and quantity of each type of material landfilled, salvaged or recycled.
   d. Weighmaster tickets can be substituted for items a and c (except for salvaged items). In all instances, weighmaster tickets must be provided with this submittal.
   e. Alternative report formats may be acceptable, but must be reviewed and approved by the UCDHS Sustainability Administrator before being used in lieu of the requirements above.

3. Legible copies of manifests, weight tickets, and receipts. Manifests shall be from recycling and/or disposal site operators that can legally accept the materials for the purpose of reuse, recycling or disposal.

4. Maintain at the Project site Waste Management Logs for each load of materials removed from site.

D. PROJECT MEETINGS

1. Discuss Waste management plans and implementation at the following meetings:
   a. Pre-construction meeting.
   b. Regular job-site meetings.

E. PROJECT CONDITIONS

1. Hazardous materials are excluded from the work of this Section. If hazardous materials are encountered or suspected, stop work in the suspect area. Refer to Section 01 35 00 Special Procedures.
F. CONSTRUCTION WASTE RECYCLING SERVICES

1. Construction waste recycling services for materials shall be those proposed by the Contractor and approved by the University.

G. The following may be suitable for diversion from landfill, though the Contractor and Contractor recyclers are responsible for final determination of suitable materials.

1. Concrete: Clean concrete, concrete with rebar, asphalt concrete.
2. Metals: Steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass or bronze, including banding, ductwork, framing, roofing and siding, flashing, piping and rebar.
3. Aggregate.
4. Wood: Clean dimensional wood, wood pallets, engineered wood products including plywood, particleboard, I joists.
5. Vegetation.
7. Masonry: Brick, ceramic tile, CMU.
8. Gypsum board.
10. Carpet and pad.
11. Paint.
12. Insulation.
13. Plastics: ABS, PVC
14. Beverage containers

H. WASTE MANAGEMENT PLAN IMPLEMENTATION

1. Coordinate waste materials handling and separation for all trades.
2. Document results of the implementation of the Waste Management Plan.
3. Provide separation bins for temporary onsite storage, handling, transportation, recycling, salvage, and landfilling for all demolition and waste materials.
4. Keep recycling and waste bins areas neat, clean and clearly marked in order to avoid contamination or mixing materials.
5. Maintain logs onsite for each load of materials removed from site.

1.5 CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN: DURING CONSTRUCTION
A. Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the building including:

1. Meet or exceed the recommended design guidelines of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines, 1995, Chapter 3. Compliance with SMACNA Guidelines shall start no later than the scheduled HVAC start up date. SMACNA Guidelines for HVAC protection and for protection of absorptive materials may need to start at an earlier stage, in accordance with the construction schedule.

2. Protect stored on-site or installed absorptive materials from moisture damage.

3. Comply with requirements of Division 23 Section – Ductwork.

B. Develop and implement an Indoor Air Quality Management Plan for the pre-occupancy phase.

1. Comply with requirements of Division 23 Section – Ductwork.

C. Submittals

   a. Submit documentation demonstrating that an Indoor Air Quality Management Plan was developed and implemented, including:

2. SMACNA IAQ Guidelines Chapter 3 implementation.

3. Stored on-site or installed abortive materials were successfully protected from moisture damage.

4. Maintaining ductwork internal cleanliness.

5. Documentation including product data, that if any air handling systems were used during construction, that any return and exhaust grilles were protected with filtration media with a Minimum Efficiency Reporting Value (MERV) of at least 13 (per ASHRAE 52.2) including filtration media manufacturer’s name, model number, and MERV value.

6. Documentation, including product data, that all filtration media was replaced prior to occupancy with filtration media with a Minimum Efficiency Reporting Value (MERV) of at least 13 (per ASHRAE 52.2) including filtration media manufacturer’s name, model number, and MERV Value.

7. Provide photographs verifying plan compliance at different phases of construction.

8. Submit documentation that a minimum two weeks building 100% outside air flush-out was completed, including dates when the flush-out was begun and completed and what steps were taken to guarantee 100% outside air usage.

9. Submit documentation for the filtration media used during the flush-out period, including filtration media manufacturer’s name, model number, and MERV value.

D. Implementation

1. HVAC Protection
2. Source Control
   a. Prefabricated insulated ductwork and insulating materials should be protected against moisture. Ductwork materials shall be stored in a dry and clean environment pending installation.
   b. Containers of wet products shall be kept closed when not used. Waste materials that can release odor or dust shall be covered or sealed.

3. Housekeeping
   a. Minimize accumulation of dust fumes, vapors, or gases upon HVAC start up.
   b. Do not run the HVAC system until after dust generating finishes, such as spray applied fireproofing and gypsum board, have been installed.
   c. Suppress dust with wetting agents or sweeping compounds. Efficient and effective dust collecting methods such as damp cloths, wet mops, and vacuum with particulate filters, or wet scrubbers shall be used.
   d. Increase the cleaning frequency when dust build-up is noticed.
   e. Remove spells or excess applications of solvent-containing products as soon as possible.
   f. Also refer to Division 23 Section – Ductwork for requirements.
   g. Water accumulated inside the building shall be removed promptly. Porous materials such as insulation, ceiling tiles, gypsum wall board, carpet and fabric furnishings shall be protected from exposure to moisture.
   h. Store volatile liquids, including fuels and solvents in closed containers and outside of the building when not in use.

4. Scheduling
   a. When possible, install carpets, furnishings and highly absorbent materials after all VOC-emitting products have been installed and fully cured.
   b. Provide sufficient ventilation and air circulation after VOC-emitting materials are installed.
   c. New MERV 13 filters shall be installed immediately following the flush and prior to building occupation. Refer to Division 23 Section – Ductwork for additional requirements. Monitoring of IAQ Plan
   d. A minimum of 18 photographs, documenting the progress of the IAQ management Plan implementation, shall be taken at the following stages:
      1. Site delivery and storage processes
2. Installation, protection, and housekeeping activities

3. Commissioning, flushing, and re-filtering of HVAC systems

Enclose with each photograph a narrative identifying the date and location where the photograph was taken, and the SMACNA strategy applied.

e. Subcontractor site coordination meetings shall be held monthly. The purpose of these meetings shall be to review the appropriate components of the IAQ Plan and to document the progress of the plan implementation. SMACNA IAQ Guidelines Appendix C shall be used as the Planning Checklist and Appendix D shall be used as the Inspection Checklist by the subcontractor.

5. Building Flush-Out

a. Building flush-out and report: The subcontractor shall conduct a building flush-out and prepare a flush-out report. The flush-out report should include:

1. Total days required and actual days conducted.

2. Hours per day required actual hours conducted.

3. Outside air percentage recommended and actual used.

PART 2 – PRODUCTS – NOT APPLICABLE TO THIS SECTION

PART 3 – EXECUTION – NOT APPLICABLE TO THIS SECTION

END OF SECTION 01 39 00
### APPENDIX A

WASTE MATERIALS ESTIMATING SHEET
(Use as many sheets as needed)

**PROJECT TITLE:**

**COMPANY:**

**DATE:**

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**TOTALS**
APPENDIX B
WASTE MANAGEMENT LOG
(Use as many sheets as needed)

PROJECT TITLE: 

COMPANY: 

LOG DATES: ___________ through ___________

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         |          |            |       |
         |          |            |       |
         |          |            |       |
         |          |            |       |
         |          |            |       |
         |          |            |       |

Totals

Note: provide weighmaster tickets with specific information on type of material recycled and weight.
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Building systems commissioning procedures and requirements for the following systems:
   1. Heating water systems.
   2. Exhaust Fans.
   4. Stair Pressurization Fan
   5. Sewage Waste Ejector Pump.
   6. Heating, Ventilating, and Air Conditioning (HVAC) System.
      a. HVAC equipment.
      b. HVAC controls systems.
      c. Building Automation System (BAS): Control hardware and software, sequence of
         operations, and integration of factory controls with BAS.
      d. HVAC piping.
      e. Ductwork.
      f. Testing, Adjusting, and Balancing (TAB).
      g. Smoke Control Sequence of Operation.
   7. Electrical System: Associated with HVAC Systems
      a. Lighting controls.
      b. Lighting occupancy sensors.
      c. Daylighting.
      d. Waste heat recovery.
      e. Thermal storage.
      f. Security system.
      g. Emergency power system.
      h. Uninterruptible power supply (UPS) system.
      i. Fire and smoke alarm system.
      j. Fire protection system.
      k. Communications system.

1.2 RELATED SECTIONS

A. Section 01 77 00 – Closeout Procedures.

B. Section 01 39 00 – Sustainable Design Requirements.
C. Section 01 39 01 – Indoor Air Quality Requirements.

D. Divisions 21-23 – Mechanical.

E. Divisions 25-28 – Electrical.

1.3 DEFINITIONS

A. Basis of Design: Documentation of the primary thought process and assumptions behind design decisions that were made to meet the design intent.

B. Commissioning Authority (CxA): The individual or entity in charge of the commissioning process and who makes final recommendations to Owner regarding functional performance of the commissioned building systems. The Commissioning Authority is not directly involved in the design or construction management and reports directly to Owner.

C. Commissioning Coordinator: The individual or entity in direct charge of the day-to-day site commissioning activities.

D. Commissioning Plan: An overall plan developed to provide the structure, schedule, and coordination plan for the commissioning process.

E. Commissioning Process: A systematic process of ensuring that building systems perform interactively according to the Contract Documents, the design intent, and Owner’s operational requirements. The commissioning processes encompass and coordinate traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training.

F. Commissioning Team: Team consisting of the Commissioning Authority, Commissioning Coordinator, Owner’s representative, Construction Manager, Architect and design engineers, General Contractor (GC), mechanical contractor(s), electrical contractor, testing and balancing contractor, controls contractor, any other installing subcontractors and equipment suppliers. If known, Owner’s facility manager, operator, or engineer is also a member of the commissioning team.

G. Functional Performance Test: The dynamic function and operation testing of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems, rather than just components, under full operation and under various modes, such as under low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.

H. Manual Test(s): Tests using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the observation).

I. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.

J. Prefunctional Checklist: A list of items to inspect and elementary component test needed to verify proper installation equipment.

K. Seasonal Performance Tests: Functional Tests that are deferred until the system(s) will experience conditions closer to their design conditions.
1.4 COMMISSIONING GOALS AND SCOPE

A. The following are the objectives of the commissioning process on each commissioned component, equipment, system, or feature:

1. Ensure that commissioned features and systems are properly installed according to the Contract Documents, manufacturers’ instructions, and industry accepted minimum standards; and that building systems or components are not compromising performance of the feature.

2. Ensure that Contractor completes start-up and initial checkout of commissioned features and systems; and that results are clearly documented in accordance with manufacturers’ instructions and the Contract Documents.

3. Verify that start-up and initial checkout of all commissioned features and systems are successfully completed using appropriate sampling techniques; and ensure, based on these sampling techniques, that control systems have successfully passed a complete point-to-point checkout and that each control point is commanding, reporting, and controlling according to the intended purpose.

4. Ensure that functional testing of components and systems are prepared, developed, conducted, and documented to test each sequence in the sequence of operations and other significant modes.

5. Ensure that Operation and Maintenance (O&M) documentation is complete, applicable, written and collated as specified.

6. Ensure that Owner’s facility personnel responsible for equipment and systems operations are adequately trained.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 78 00.

B. Required submittals of building systems identified for commissioning are subject to review by Commissioning Authority, Commissioning Coordinator, Construction Manager, and Architect and design engineers.

C. Product Data: Submit manufacturer’s descriptive literature of commissioned equipment and systems as specified in individual specification sections. As a minimum, data shall include the following:

1. Manufacturer and model number.

2. Manufacturer’s printed installation and detailed start-up procedures.

3. Full sequence of operations.

4. Operation and Maintenance (O&M) data.

5. Performance data.

6. Performance test procedures.

7. Control drawings and details of Owner contracted tests.

8. Installation and checkout materials shipped together with equipment and actual field checkout sheet forms for use by factory or field technicians.

D. Commissioning Process Submittals:
1. Qualifications of Commissioning Coordinator and Inspection and Testing Agencies.
2. Basis of Design and Design Intent.
3. Commissioning Plan including test procedures and forms.
4. Scoping Meeting Minutes.
5. Deficiency report and resolution record.
6. Final commissioning report appendices.
7. Start-up and initial checkout plan.
8. Project work schedule with testing and commissioning activities incorporated.

E. Closeout Submittals:
2. Training of Owner's Facility Personnel:
   a. Training Plan.
   b. Videotape of training sessions.

1.6 COMMISSIONING AUTHORITY

A. Owner will employ a Commissioning Authority in charge of the commissioning process.

B. Duties and Responsibilities:
   1. Make final recommendation to Owner regarding functional performance of the commissioned building.
   2. Oversee work of Commissioning Coordinator.
   3. Regularly communicate with members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos and progress reports.
   4. Review and approve commissioning process submittals and reports.
   5. Witness selected tests and perform selected construction observation.

1.7 COMMISSIONING COORDINATOR

A. Contractor shall employ a Commissioning Coordinator, acceptable to Owner, Commissioning Authority, Construction Manager, and Architect.

B. Qualifications:
   1. Commissioning Coordinator: Individual or entity normally engaged in providing building system commissioning services specialized in the types of inspections and tests required.
   2. Inspection and testing service agencies shall be members of the Building Commissioning Association (BCA).

C. Duties and Responsibilities:
   1. Primary role: Develop and coordinate the execution of a commissioning plan which includes the testing, observing, and documenting systems performance and ensure that systems are functioning in accordance with the design intent in accordance with the
Contract Documents.

2. In charge of day-to-day site commissioning activities and directly oversee site commissioning work executed by themselves, Contractor, subcontractors, or consultants.

3. Prepare commissioning plan.

4. Develop standard forms as part of commissioning plan.

5. Work with subcontractors in developing startup documentation formats, including providing subcontractors with prefunctional checklists to be completed during startup processes.

6. Prepare test procedures.

7. Generate first-hand commissioning reports.

1.8 COMMISSIONING PLAN

A. Within fourteen days after receipt of Notice of Award, Commissioning Coordinator shall prepare a preliminary Commissioning Plan for approval by the Commissioning Authority. Commissioning Plan shall be updated and finalized after scoping meeting.

B. Commissioning Plan shall identify how commissioning activities will be integrated into general construction and trade activities and identify how commissioning responsibilities are distributed. This shall include the following:

1. Designation of responsibilities for producing various procedures and reports.

2. Commissioning schedule.

3. Description of tests and acceptance procedures.

1.9 COMMISSIONING SCOPING MEETING

A. Thirty days to sixty days from project start date, the Commissioning Authority will schedule, plan and conduct a commissioning scoping meeting to discuss the following:

1. Review and finalize commissioning plan for implementation; establish scope of work, tasks, schedules, deliverables, and responsibilities.

2. Review each building system to be commissioned, including its intended operation, commissioning requirements, and completion start-up schedules.

B. Commissioning Coordinator shall prepare and distribute meeting minutes to all parties.

C. Attendance: Commissioning Team members.
1.10 COMMISSIONING MEETINGS

A. During the course of construction, commissioning meetings shall be planned and conducted by the Commissioning Authority to cover coordination, deficiency resolution, and planning issues with particular subcontractors.

B. Commissioning Coordinator shall coordinate with Commissioning Authority, Construction Manager, and Contractor in scheduling commissioning meetings to interface with construction progress as scheduled.

1.11 START-UP, PREFUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

A. Commissioning Coordinator shall prepare a prefunctional checklist to ensure that equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays.

B. Prefunctional checkout shall be performed on each piece of equipment. Successful completion of prefunctional testing for a given system is required prior to formal functional performance testing of equipment or subsystems of the given system.

C. Commissioning Coordinator shall prepare detailed start-up plans for all commissioned equipment for review and approval by Commissioning Authority. Start-up plans shall include the following:
   1. Prefunctional checklist.
   2. Manufacturer’s standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block.
   3. Manufacturer’s field checkout sheets.

1.12 FUNCTIONAL PERFORMANCE TESTING

A. Commissioning Coordinator shall develop Functional Performance Test Procedures for review and approval of Commissioning Authority.

B. Fully describe Functional Performance Test Procedures including system configuration and steps required for each test, appropriately documented so that another party can repeat the tests with identical results.

   1. Test Methods: Functional performance testing and verification may be achieved by:
      a. Direct manipulation of system inputs (i.e. heating or cooling sensors),
      b. Manipulation of system inputs with building automation system (i.e. software override of sensor inputs), and
      c. Trend logs of system inputs and outputs using stand alone data loggers.
      d. A combination of methods may be required to completely test the complete sequence of operations. The Commissioning Coordinator shall recommend to Commissioning Authority which method, or combination, is most appropriate.

   2. Setup: Each test procedure shall be performed under conditions that simulate normal operating conditions as closely as possible. Where equipment requires integral safety devices to stop/prevent equipment operation until minimum safety standards or conditions are met, functional test procedures shall demonstrate the actual performance of safety shutoffs in a real or closely simulated condition of failure.
3. Sampling: Multiple identical pieces of non-life-safety or critical equipment may be functionally tested using a sampling strategy. The sampling strategy shall be developed by the Commissioning Coordinator for approval by the Commissioning Authority. If after three attempts at testing the specified sample percentage, failures are still present, then all remaining units shall be tested at the Contractor’s expense.

C. Develop functional performance test procedures for equipment and systems. Identify test procedures and forms to verify and document proper operation of each piece of equipment and system. Coordinate test procedures with Contractor for feasibility, safety, equipment and warranty protection. Functional performance test forms shall include the following:

1. System and equipment or component name(s).
2. Equipment location and ID number.
3. Date.
4. Project name.
5. Participating parties.
6. Instructions for setting up the test, including special cautions, alarm limits, etc.
7. Specific step-by-step procedures to execute the test.
8. Acceptance criteria of proper performance with a Yes/No check box.
9. A section for comments.

D. Functional performance testing shall not begin until prefunctional, start-up and TAB is completed for a given system.

E. Controls system and equipment it controls shall not be functionally tested until all points have been calibrated and prefunctional checklists are completed.

1.13 SHORT-TERM DIAGNOSTIC TESTING

A. After initial occupancy, perform short-term diagnostic testing, using data acquisition equipment or the building automation system to record system operation over a two week to three week period.

B. Investigate the dynamic interactions between components in the building system.

C. Evaluate the scheduling, the interaction between heating and cooling, and the effectiveness of the HVAC system in meeting the comfort requirements.

1.14 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

A. Commissioning Coordinator witnesses and documents functional performance tests. Commissioning Authority may witness selected tests.

B. Contractor shall cooperate in expediting testing procedures and minimize delays without compromising integrity of the procedures. Contractor shall include time for testing and correcting in programming the project work schedule.

C. Non-Conformance:

1. Document deficiencies or non-conformance observed during functional tests. At the discretion of the Commissioning Coordinator, minor deficiencies may be corrected during the tests. These deficiencies and action taken shall be documented, as well.
2. Document proposed corrective measures and course of action for deficiencies identified during test procedures.

D. Action on Deficiencies:
   1. Commissioning Coordinator shall call the attention of the Commissioning Authority on all deficiencies.
   2. If there is no dispute on the deficiency and the responsibility to correct it:
      a. The Commissioning Coordinator documents the deficiency and the adjustments or alterations required to correct it.
      b. Contractor corrects the deficiency and notifies the Commissioning Coordinator that the equipment is ready to be retested.
      c. Commissioning Coordinator reschedules the test and the test is repeated.
   3. If there is a dispute about a deficiency or who is responsible:
      a. Commissioning coordinator documents the deficiency on the non-compliance form and a copy is given to the Commissioning Authority.
      b. Resolutions are made at the lowest management level possible. Additional parties are brought into the discussions as needed. Final authority is with Owner.
      c. Commissioning Coordinator documents the resolution process.
      d. Once the resolution has been decided, the appropriate party corrects the deficiency and notifies the Commissioning Coordinator that the equipment is ready to be retested.
      e. Commissioning Coordinator reschedules the test and the test is repeated.
   4. Tests are repeated until satisfactory performance is achieved.
   5. Costs for retesting shall be charged to the party responsible for the deficiency.

E. Commissioning Coordinator notes each satisfactorily demonstrated function. Formal approval of functional test is issued by Commissioning Authority.

F. Commissioning Coordinator compiles commissioning process documentation including logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc. for inclusion as appendices to the Commissioning Authority’s final summary report.

G. Commissioning Coordinator compiles prefunctional checklists, functional tests, and monitoring reports for inclusion in the operation and maintenance manuals.

1.15 OPERATION AND MAINTENANCE (O&M) MANUALS

A. Comply with Section 01 39 00 and related Sections in Divisions 21-23 and 25-31.

B. Commissioning Coordinator compiles operation and maintenance manuals and includes commissioning records as attachments which includes the following:
   3. System Type(s).
      a. Design narrative and criteria, sequences, equipment approvals.
      b. Start-up plan and report, approvals, corrections, prefunctional checklists.
c. Functional tests, trending and analysis, approvals, corrections, and training plan.
4. Facility training materials and videotape.

1.16 FINAL COMMISSIONING REPORT

A. Commissioning Authority prepares a final summary report with recommendations to Owner regarding functional performance of the commissioned building systems.

1.17 DEFERRED TESTING

A. Unforeseen Deferred Tests: Tests that cannot be completed due to the building structure, required occupancy condition, or other deficiency, functional testing may be deferred only with the approval of Commissioning Authority and Owner. Any additional cost for deferred testing shall be borne by Contractor.

B. Seasonal Testing: NOT USED

1. Commissioning Coordinator shall schedule, coordinate, observe, and document additional testing for seasonal variation in operations and control strategies during the opposite season to verify performance of the HVAC system and controls. Complete testing during the warranty period to fully test all sequences of operation.

2. Correct deficiencies and fine adjust systems. Update operation and maintenance manuals and record drawings as necessary. Include documentation of these tests in the operation and maintenance manual.

C. End-of-Warranty Review:

1. Conduct end of warranty review prior to the end of the warranty period.

2. Review the current building operation with the facility maintenance staff. The warranty review shall include outstanding issues from original or seasonal testing.

3. Interview facility staff to identify concerns with building operation. Provide suggestions for improvements and assist Owner in developing reports or documentation to remedy problems.

4. Update operation and maintenance manual as needed.

1.18 TRAINING OF OWNER’S FACILITY PERSONNEL

A. Contractor shall coordinate and schedule training of Owner’s facility personnel responsible for the operation and maintenance of commissioned systems.

B. Contractor shall submit a training plan for each commissioned equipment prior to training sessions, which shall, at a minimum, consist of the following:

1. Intended audience.
2. Objective.
3. Location.
4. Scope.
5. Duration.
6. Methods (may include lecture, video, site walk-through, actual operational demonstration, written handouts).
7. Instructor and qualifications.

C. Videotape training sessions and include these in the operation and maintenance manuals.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

A. Instrumentation shall meet the following standards:
   1. Be of sufficient quality and accuracy to test and measure system performance within the tolerances required to determine adequate performance.
   2. Be calibrated on the manufacturer’s recommended intervals with calibration tags permanently affixed to the instrument being used.
   3. Be maintained in good repair and operation condition throughout the duration of use on this project.

B. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Contractor for the equipment being tested.

C. Datalogging equipment or software required to test equipment will be provided by the Commissioning Coordinator, but shall not become the property of Owner.

PART 3 EXECUTION

3.1 PRE-FUNCTIONAL CHECKLISTS AND FACTORY START UP REPORTS

A. THE FOLLOWING PROCEDURES APPLY TO ALL EQUIPMENT TO BE COMMISSIONED.


C. EXECUTION OF PRE-FUNCTIONAL CHECKLISTS AND STARTUP.

   1. PRE FUNCTIONAL CHECKLISTS WILL BE PROVIDED TO THE PROJECT SITE BY THE CXA.
2. THE CONTRACTOR SHALL MAINTAIN A MASTER COPY OF SIGNED CHECKLISTS.

3. THE INSTALLING CONTRACTORS SHALL UPDATE THE CHECKLISTS AS WORK IS COMPLETED. ONLY INDIVIDUALS THAT HAVE DIRECT KNOWLEDGE AND WITNESSED THAT A LINE ITEM TASK ON THE PRE-FUNCTIONAL CHECKLIST WAS ACTUALLY PERFORMED SHALL INITIAL OR CHECK THAT ITEM OFF.

4. THE CXA WILL PERIODICALLY REVIEW THE CHECKLISTS FOR COMPLETENESS AND REPORT ON PROGRESS AT THE CX MEETINGS.

D. DEFICIENCIES, NON-CONFORMANCE AND APPROVAL IN CHECKLISTS AND STARTUP.

1. THE CONTRACTOR SHALL CLEARLY LIST ANY OUTSTANDING ITEMS OF THE INITIAL START-UP AND PRE-FUNCTIONAL PROCEDURES THAT WERE NOT COMPLETED SUCCESSFULLY, AT THE BOTTOM OF THE PROCEDURES FORM OR ON AN ATTACHED SHEET. THE PROCEDURES FORM AND ANY OUTSTANDING DEFICIENCIES ARE PROVIDED TO THE CXA WITHIN TWO DAYS OF TEST COMPLETION.

2. THE CXA REVIEWS THE REPORT AND REPORTS TO THE UNIVERSITY. THE CXA SHALL WORK WITH THE CONTRACTOR AND VENDORS TO CORRECT AND RETEST DEFICIENCIES OR UNCOMPLETED ITEMS.

3.2 FUNCTIONAL PERFORMANCE TESTING

A. OBJECTIVES AND SCOPE. THE OBJECTIVE OF FUNCTIONAL PERFORMANCE TESTING IS TO DEMONSTRATE THAT EACH SYSTEM IS OPERATING ACCORDING TO THE CONTRACT DOCUMENTS. EACH SYSTEM WILL BE TESTED TO VERIFY THAT THE SYSTEM RESPONSE IS AS DESIGNED. HVAC SYSTEMS WILL BE CHECKED FOR CONFORMANCE TO THE DESIGN SEQUENCES OF OPERATION AND STABLE CONTROL, LIGHTING CONTROL WILL BE CHECKED IN EACH TYPE OF LIGHTING AREA, SECURITY SYSTEM CAMERAS WILL BE VERIFIED FUNCTIONAL AND ABLE TO SEE THE CORRECT AREAS. PROPER SYSTEM RESPONSES TO SUCH CONDITIONS AS POWER FAILURE, OUT OF LIMIT CONDITION, EQUIPMENT FAILURE, ETC. SHALL ALSO BE TESTED.

B. NOT USED.

C. DEVELOPMENT OF TEST PROCEDURES: THE TEST PROCEDURES ARE WRITTEN BY THE CXA BASED UPON THE FINAL OPERATIONAL SEQUENCES FROM AVAILABLE PROJECT DOCUMENTATION. THE CXA SHALL DEVELOP SPECIFIC TEST PROCEDURES AND FORMS TO VERIFY AND DOCUMENT PROPER OPERATION OF
EACH SYSTEM. PRIOR TO EXECUTION, THE CXA SHALL PROVIDE A COPY OF THE TEST PROCEDURES TO THE CONTRACTOR WHO SHALL REVIEW THE TESTS FOR FEASIBILITY, SAFETY, EQUIPMENT AND WARRANTY PROTECTION. THE TEST PROCEDURE CHECKLISTS DEVELOPED BY THE CXA SHALL INCLUDE THE FOLLOWING INFORMATION:

1. SYSTEM AND EQUIPMENT OR COMPONENT NAME(S).
2. EQUIPMENT LOCATION AND ID NUMBER.
3. DATE.
4. PROJECT NAME.
5. PARTICIPATING PARTIES.
6. REFERENCE TO THE SPECIFICATION SECTION DESCRIBING THE TEST REQUIREMENTS, IF APPLICABLE.
7. A COPY OF THE SPECIFIC SEQUENCE OF OPERATIONS.
8. PREREQUISITES FOR THE TEST.
9. SPECIAL CAUTIONS, ALARM LIMITS, ETC.
10. SPECIFIC STEP-BY-STEP PROCEDURES TO EXECUTE THE TEST.
11. ACCEPTANCE CRITERIA OF PROPER PERFORMANCE WITH A YES / NO/NA CHECK BOX.
12. A SECTION FOR COMMENTS.

D. TEST METHODS.

1. FUNCTIONAL TESTING IS PERFORMED BY THE CONTRACTORS WITH THE METHOD AND DEGREE OF TESTING AS DEFINED IN THIS SPECIFICATION FOR EACH SYSTEM. EACH FUNCTION AND TEST SHALL BE PERFORMED UNDER CONDITIONS THAT SIMULATE ACTUAL CONDITIONS AS CLOSE AS IS PRACTICALLY POSSIBLE. THE CONTRACTOR EXECUTING THE TEST SHALL PROVIDE ALL NECESSARY MATERIALS, SYSTEM MODIFICATIONS, ETC. TO PRODUCE THE NECESSARY FLOWS, PRESSURES, TEMPERATURES, ETC. NECESSARY TO EXECUTE THE TEST ACCORDING TO THE SPECIFIED CONDITIONS. AT COMPLETION OF THE TEST, THE
CONTRACTOR SHALL RETURN ALL AFFECTED BUILDING EQUIPMENT AND SYSTEMS TO THEIR PRE-TEST CONDITION.

2. MULTIPLE IDENTICAL PIECES OF EQUIPMENT MAY BE FUNCTIONALLY TESTED USING A SAMPLING STRATEGY. THE SAMPLING STRATEGY WILL BE DEFINED IN THESE SPECIFICATIONS WITH THE COMMISSIONED SYSTEMS LIST.

E. COORDINATION AND SCHEDULING: THE CONTRACTOR SHALL PROVIDE SUFFICIENT NOTICE TO THE CXA REGARDING THEIR COMPLETION SCHEDULE FOR THE PRE-FUNCTIONAL CHECKLISTS AND STARTUP OF ALL EQUIPMENT AND SYSTEMS. THE CXA WILL SCHEDULE FUNCTIONAL TESTS THROUGH THE OWNERS REPRESENTATIVE AND CONTRACTOR. PROBLEM SOLVING: THE CXA WILL RECOMMEND SOLUTIONS TO PROBLEMS FOUND; HOWEVER THE BURDEN OF RESPONSIBILITY TO SOLVE, CORRECT AND RETEST PROBLEMS IS WITH THE CONTRACTOR AND OWNER’S CONSULTANTS.


3.3 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

A. BEFORE THE OPERATION AND MAINTENANCE TRAINING, CXA SHALL REVIEW TRAINING PREPARATION FOR COMPLIANCE WITH PROJECT DOCUMENTS.

B. TRAINING IS REQUIRED PER CONTRACT SPECIFICATIONS. AT A MINIMUM, TRAINING IS REQUIRED FOR MECHANICAL SYSTEMS, LIGHTING, AND CONTROLS SYSTEMS.

C. THE CXA REQUIRES SUBMISSION OF TRAINING RECORDS INCLUDING ATTENDANCE LISTS TO VERIFY APPROPRIATE PEOPLE RECEIVED THE TRAINING.

3.4 COSTS OF COMMISSIONING WORK

A. THE COST TO THE CONTRACTOR AND SUBCONTRACTORS TO COMPLY WITH THE SPECIFIED CX REQUIREMENTS AND TO SUPPORT THE WORK OF THE CXA SHALL BE INCLUDED IN THE CONTRACTOR’S AND SUBCONTRACTOR’S BID PRICE.
B. IF A DEVICE, PIECE OF EQUIPMENT, SEQUENCE, OR SYSTEM FAILS A TEST, CORRECTIONS SHALL BE MADE AND A SECOND TEST SHALL BE PERFORMED. IF THE SECOND TEST IS NOT SUCCESSFUL, THEN THE CXA’S COST FOR A THIRD TEST OR SUBSEQUENT TESTS SHALL BE REIMBURSED TO THE CXA BY THE CONTRACTOR. SEE GENERAL CONDITIONS ARTICLE 1.1.15, & SECTION 01 45 50 SUBSECTION 1.5 D.

3.5 COMMISSIONED SYSTEMS

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<td>Security System</td>
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PART 4  LEVELS DEFINED:

LEVEL 1 - THE CXA WILL PERIODICALLY OBSERVE AND VERIFY THE INSTALLATION OF EQUIPMENT AND SYSTEMS AND REVIEW PROJECT DOCUMENTATION (TEST REPORTS) TO VERIFY OPERATIONAL REQUIREMENTS MEET THE CONTRACT DOCUMENTS.

LEVEL 2 - THE CXA WILL PERIODICALLY OBSERVE AND VERIFY THE INSTALLATION OF EQUIPMENT AND SYSTEMS AND REVIEW PROJECT DOCUMENTATION (TEST REPORTS). THE CXA MAY SPOT CHECK SOME OF THE SYSTEM FUNCTIONS VERIFY OPERATIONAL REQUIREMENTS ARE MET.

LEVEL 3 - THE CXA WILL PERIODICALLY OBSERVE AND VERIFY THE INSTALLATION OF EQUIPMENT AND SYSTEMS AND REVIEW PROJECT DOCUMENTATION (TEST REPORTS) AND WILL WITNESS CONTRACTOR PERFORMANCE TESTING OF THE SYSTEM. CONTRACTOR SHALL TEST UP TO 20% OF THE SYSTEM TO PROVE OPERATIONAL REQUIREMENTS ARE MET. THE TEST SECTIONS SHALL BE CHOSEN AT RANDOM BY THE CXA. FAILURE OF ANY TEST SECTION SHALL REQUIRE RETESTING OF THAT SECTION AND AN ADDITIONAL TEST SECTION EQUIVALENT IN SCOPE.

LEVEL 4 - THE CXA WILL PERIODICALLY OBSERVE AND VERIFY THE INSTALLATION OF EQUIPMENT AND SYSTEMS AND REVIEW PROJECT DOCUMENTATION (TEST REPORTS) AND WILL WITNESS CONTRACTOR PERFORMANCE TESTING OF THE SYSTEM. CONTRACTOR SHALL TEST UP TO 50% OF THE SYSTEM TO PROVE OPERATIONAL REQUIREMENTS ARE MET. THE TEST SECTIONS SHALL BE CHOSEN AT RANDOM BY THE CXA. FAILURE OF ANY TEST SECTION SHALL REQUIRE RETESTING OF THAT SECTION AND AN ADDITIONAL TEST SECTION EQUIVALENT IN SCOPE.

LEVEL 5 - THE CXA WILL PERIODICALLY OBSERVE AND VERIFY THE INSTALLATION OF EQUIPMENT AND SYSTEMS AND REVIEW PROJECT DOCUMENTATION (TEST REPORTS) AND WILL WITNESS CONTRACTOR PERFORMANCE TESTING OF THE SYSTEM. CONTRACTOR SHALL TEST UP TO 100% OF THE SYSTEM TO PROVE OPERATIONAL REQUIREMENTS ARE MET. THE TEST SECTIONS SHALL BE CHOSEN AT RANDOM BY THE CXA. FAILURE OF ANY TEST SECTION SHALL REQUIRE
RETESTING OF THAT SECTION AND AN ADDITIONAL TEST SECTION EQUIVALENT IN SCOPE.

3.6 METHODS OF TESTING:

A. HVAC&R SYSTEMS

1. CONTRACTOR WILL DEMONSTRATE TO THE CXA THAT THE OPERATION OF EACH SYSTEM THROUGH ALL MODES, ALARMS, AND OPERATING PARAMETERS MEET THE PROJECT SPECIFICATIONS.

2. THE TAB CONTACTER WILL RE-MEASURE UP TO 25% THE FINAL TAB REPORT FOR THE CXA TO OBSERVE. THE POINTS TO BE VERIFIED WILL BE SELECTED BY THE CXA.

B. BUILDING MANAGEMENT SYSTEM:

1. THE CONTROLS CONTACTER WILL RE-MEASURE SOME OF THE POINTS FOR THE CXA TO OBSERVE THAT THE CALIBRATION IS CORRECT. THE POINTS TO BE VERIFIED WILL BE SELECTED BY THE CXA.

2. ALL OF THE USER GRAPHICS INTERFACES AND DISPLAYED OPERATING POINTS WILL BE DEMONSTRATED FOR THE CXA BY THE CONTRACTOR.

3. CONTROLS CONTRACTOR SHALL MANIPULATE THE SYSTEM TO DEMONSTRATE THAT IT PERFORMS ALL OF THE SPECIFIED MODES OF OPERATION.

C. ELECTRICAL SYSTEMS

1. CXA WILL REVIEW SUBMITTALS AND DOCUMENTATION.

2. CXA WILL OBSERVE INSTALLATION OF EQUIPMENT AND SYSTEMS DURING CONSTRUCTION TO VERIFY COMPLIANCE TO CONTRACT REQUIREMENTS.

END OF SECTION 01 39 03
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Relationship between Code, Ordinances, Standards and Contract Documents
B. Applicable Codes, Laws and Ordinances
C. Project Inspections
D. Office of Statewide Health Planning & Development Projects

1.2 RELATED SECTIONS

A. Section 01 35 00 – SPECIAL PROCEDURES
B. Section 01 42 00 – REFERENCES
C. Section 01 45 00 – QUALITY CONTROL

1.3 RELATIONSHIP BETWEEN CODES, ORDINANCES, STANDARDS AND THE CONTRACT DOCUMENTS

A. Authority: All codes, ordinances and standards referenced in Contract Documents shall have full force and effect as though printed in their entirety in the Contract Specifications.

B. Precedence:

1. Where specified requirements differ from requirements of applicable codes, ordinances and standards, the more stringent requirements shall take precedence.

2. Where Contract Drawings or Contract Specifications require or describe products or execution of better quality, higher standard or greater size than required by applicable codes, ordinances and standards, the Contract Drawings and Contract Specifications shall take precedence so long as such increase is legal.

3. Where no requirements are identified in Contract Documents, comply with all requirements of applicable codes, ordinances and standards of governing authorities having jurisdiction.

1.4 APPLICABLE CODES, LAWS AND ORDINANCES

A. Building Codes:

1. Work shall meet or exceed the requirements of and be performed in accordance with applicable code requirements and requirements of all other regulatory agencies, including, but not limited to the following:

   a. 2013 California Building Standards Administrative Code – Title 24 Part 1


d. 2013 California Electrical Code, based on 2011 National Electrical Code – Title 24 Part 3

e. 2013 California Mechanical Code, based on 2012 Uniform Mechanical Code – Title 24 Part 4


g. 2013 California Energy Code – Title 24 Part 6

h. 2013 California Historical Building Code – Title 24 Part 8

i. 2013 California Fire Code, based on 2012 International Fire Code – Title 24 Part 9

j. 2013 California Code for Building Conservation – Title 24 Part 10

k. 2013 California Referenced Standards Code – Title 24 Part 12

l. 2013 NFPA 13 – Installation of Sprinkler Systems

m. 2013 NFPA 14 – Installation of Standpipe and Hose System

n. 2013 NFPA 72 – National Fire Alarm Code

o. 2013 NFPA 80 – Fire Door and Other Opening Protection

p. 2005 NFPA 99 – Health Care Facilities


r. 2003 NFPA 252 – Standard Method of Fire Door Assembly

s. 2007 NFPA 701 – Standard Method of Fire Test for Flame Propagation of Textiles and Films

t. California Code of Regulations, Current Editions:

1) Title 8, Industrial Relations

2) Title 17, Public Health (Chapter 7)

3) Title 19, Public Safety

4) Title 21, Public Works

5) Title 22, Social Security
6) Title 24, Parts 1, 2, 3, 4, 5, 9 and 12
7) Title 25, Energy Insulation Standards
u. Americans with Disabilities Act (ADA) 2010
v. OSHPD
w. Rules and regulations of private and public utilities
x. American National Standards Institute (ANSI)
y. American Society of Testing Materials (ASTM)
z. Federal Specifications (Fed. Spec.)
aa. Underwriters Laboratories
bb. National Fire Protection Association (NFPA) (as adopted by State agencies)

2. All dates to comply with edition accepted by University and California State Fire Marshal (CSFM).

3. Unless otherwise specified, specific references to codes, regulations, standards, manufacturers' instructions, or requirements of regulatory agencies, when used to specify requirements for materials or design elements, shall mean the latest edition of each in effect at the date of submission of bids, or the date of the Change Order, as applicable.

4. References on Drawings or in Specifications to "code" or "building code' not otherwise identified shall mean the codes specified above, together with all additions, amendments, changes, and interpretations adopted by code authorities of the jurisdiction having authority over the project.

B. Other Applicable Laws, Ordinances and Regulations:

1. Work shall be accomplished in conformance with all applicable laws, ordinances, rules and regulations of Federal, State and local governmental agencies and jurisdictions having authority over the Project.

2. Work shall be accomplished in conformance with all regulations of Public Utilities and utility districts.

3. Where such laws, ordinances, rules and regulations require more care or greater time to accomplish Work, or require better quality, higher standards or greater size of products, Work shall be accomplished in conformance to such requirements with no change to Contract Time or Contract Sum, except where changes in laws, ordinances, rules and regulations occur subsequent to execution date of the Agreement.

4. General Contractor shall not self-perform specialty contracting work defined in Sections 7055 – 7059.1 of the California Business and Professions Code unless the General Contractor has the Specialty Contractors license appropriate for the work performed. Otherwise,
Specialty Contractors shall be retained by the General Contractor to perform specialty work identified in the project scope.

1.5 PROJECT INSPECTIONS

A. Provision of inspectors by University, if any, or by Office of Statewide Health Planning and Development pursuant to this Section and Section 1.4 above shall be subject to the following:

1. Contractor shall allow inspectors full access to Project at all times.
2. Contractor shall not take any direction, approvals or disapprovals from inspectors.
3. Contractor shall not rely on inspectors to ensure Work is completed in accordance with Contract Documents.
4. Acts of omissions of any inspector (including without limitation inspector's failure to observe or report deficiencies in Contractor's Work) shall not relieve Contractor for responsibility to complete Work in accordance with Contract Documents.

1.6 OFFICE OF STATEWIDE HEALTH PLANNING AND DEVELOPMENT PROJECTS

A. Office of Statewide Health Planning and Development (OSHPD), located at 400 “R” Street, Suite 200, Sacramento, CA. 95811, is the agency having jurisdiction over all acute care medical project design and construction.

B. OSHPD will approve an inspector for the Project who shall have full access to the Project at all times.

C. OSHPD will require Verified Report forms to be filed per testing, inspection and observation form during construction and a final verified report at completion of the project. Separate verified reports are required from Consultants, Project Inspector, and Contractor.

D. OSHPD will require a Building Permit for project submitted by University's Representative. No OSHPD Building Permit fees are required to be paid by the Contractor.

E. OSHPD will require Change Order Approval submitted by University's Representative.

F. OSHPD will require a Licensed Contractor's Declaration from the Contractor.

1.7 DEFERRED APPROVAL

A. Where noted in the Contract Documents, certain items of materials and/or systems may require OSHPD deferred approval pending submittals of shop drawings. For these items, Contractor shall submit details and structural calculations for anchorage, to comply with State of California Code of Regulations Title 24, table T17-23-J. Calculations shall be made by a licensed Structural Engineer registered in the State of California.
PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 41 00
SECTION 01 42 00
REFERENCES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Definitions and terms used in Contract Documents.

B. Reference Standards used in Contract Documents.

C. Common abbreviations and acronyms which may be used in Contract Documents.

1.2 RELATED SECTIONS

A. Section 01 41 00 – REGULATORY REQUIREMENTS

1.3 DEFINITIONS OF TERMS

A. Basic Contract Definitions: Words and terms governing the Work are defined in the General Conditions of the Contract, provided in the Contract Documents.

B. Additional words and terms are used in the Drawings and Specifications and are defined as follows:

1. Applicable: As appropriate for the particular condition, circumstance or situation.

2. Approve (d): Used in conjunction with action on submittals, applications, and requests, is limited to duties and responsibilities stated in the General Conditions. Approvals shall only be valid if obtained in writing and shall not apply to matters regarding the means, methods, techniques, sequences and procedures of construction. Approval shall not release Contractor from responsibility to fulfill Contract requirements.

3. And/or: If used, shall mean that either or both of the items so joined are required.

4. By others: Work on the project that is outside the scope of Work to be performed under the Contract, but that will be performed by University, separate contractors or other means.

5. Contractor-Furnished/University-Installed (CFUI): Items, systems or equipment purchased by the Contractor as part of the project and handed over to the University for installation.

6. Directed: As instructed by University or University's Representative, in writing, regarding matters other than the means, methods, techniques, sequences and procedures of construction. Terms such as "directed", "requested", "authorized", "selected", approved", "required", and "permitted" mean "directed by University's Representative", requested by University's Consultant" or University's Representative and similar phrases. No implied meaning shall be interpreted to extend the University's Representative responsibility into Contractor's supervision of construction.
7. Equal or Equivalent: As determined by the University's Consultant as being of the same quality, appearance, utility, durability, finish, function, suitability, and performance.

8. Furnish: Means "supply and deliver, ready for unloading, unpacking, assembly, installation, and similar operations".

9. Indicated: Refers to graphic representations, notes or schedules on Drawings, or Paragraphs or Schedules in Specifications, and similar requirements in Contract Documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used, it is to help locate the reference.

10. Install: Describes operations at the site including unloading, unpacking, assembly, erection, anchoring, applying, working to dimension, protecting, cleaning, and similar operations.

11. Installer: "Installer" is the Contractor or an entity engaged by the Contractor, as an employee, subcontractor, or sub-subcontractor for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
   
   a. Experienced Installer: The term "experienced", when used with "installer" means having a minimum of five (5) previous Projects similar in size to this Project, and familiar with the precautions required, and with requirements of the authority having jurisdiction.


13. Necessary: as determined in the professional judgement of the University Representative through the University's Consultant as being necessary for the Work, in conformance with the requirements of the Contract Documents, and excluding matters regarding the means, methods, techniques, sequences and procedures of construction.

14. Noted: Same as indicated.

15. Owner-Furnished/Contractor-Installed (UFCI): Item, system or equipment furnished by University at its cost and installed by the Contractor as part of the Work.

16. Per: In accordance with or in compliance with.

17. Products: Materials, systems or equipment.

18. Project site: Same as site.

19. Proper: As determined by the University's Representative as being proper for the Work, excluding matters regarding the means, methods, techniques, sequences and procedures of construction, which are solely the Contractor's responsibility to determine.

20. Provide: Means "furnish and install, complete and ready for use".
21. Regulation: Includes laws, ordinances, statutes and lawful orders issued by authorities having jurisdiction, and rules, conventions and agreements within the construction industry that control performance of the Work, whether lawfully imposed by authorities having jurisdiction or not.

22. Required:
   a. As required by regulatory requirements of governing authorities.
   b. As required by referenced standards.
   c. As required by existing job conditions.
   d. As generally provided by accepted construction practices of the locale.
   e. As indicated on the Drawings and in the Specifications.
   f. As otherwise required by the Contract Documents.

23. Scheduled: Same as indicated.

24. Selected: As selected by University's Representative or University's Consultant from the full national product selection of the manufacturer, unless otherwise specifically limited in the Contract Documents to a particular quality, color, texture or price range.

25. Shown: Same as indicated.

26. Site: Same as Site of the Work or Project Site; the area or areas or spaces occupied by the Project and including adjacent areas and other related areas occupied or used by the Contractor for construction activities, either exclusively or with others performing other construction on the Project. The extent of the Project Site is shown on the Drawings, and may or may not be identical with the description of the land upon which the Project is to be built.

27. Testing Laboratories: Same as Testing and Inspection Agency.

28. Testing and Inspection Agency: An independent entity engaged to perform specific inspections or tests, at the Project Site or elsewhere, and to report on, and, if required, to interpret, results of those inspections or tests.

29. University-Furnished/Contractor-Installed (UFCI): Same as Owner-Furnished/Contractor-Installed.

1.4 REFERENCE STANDARDS

A. References: The Drawings and Specifications contain references to various standards, standard specifications, codes, practices and requirements for products, execution, tests, and inspections. These reference standards are published and issued by the agencies, associations, organizations and societies listed in this Section or identified in individual Sections of the Specifications.

B. Relationship to Drawings and Specifications: Such references are incorporated into and made a part of the Drawings and Specifications to the extent applicable.
C. Referenced grades, Classes and Types: Where an alternative or optional grade, class or type of product or execution is included in a reference but is not identified in the Drawings or Specifications, provide the highest, best and greatest of the alternatives or options for the intended use and prevailing conditions.

D. Copies of Reference Standards:

1. Reference standards are not furnished with the Drawings and Specifications. It is the responsibility of the Contractor, subcontractors, manufacturers, suppliers, trades and crafts to be familiar with these generally recognized standards of the construction industry.

E. Jobsite Copies:

1. Contractor shall obtain and maintain at the Project site copies of reference standards identified on the Drawings and in the Specifications in order to properly execute the Work.

F. Edition Date of References:

1. When an edition or effective date of a reference is not given, it shall be understood to be the current edition or latest revision published as of the date of the Contract.

2. All amendments, changes, errata, and supplements as of the effective date shall be included.

G. ASTM and ANSI References: Specifications and Standards of the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI) are identified in the Drawings and Specifications by abbreviation and number only and may not be further identified by title, date, revision or amendment. It is the responsibility of the Contractor to be familiar with and have access to these nationally, and industry recognized specifications and standards.

1.5 ABBREVIATIONS & ACRONYMS

A. Abbreviations and Names: Where acronyms or abbreviations are used in the Specifications or other Contract Documents they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction or other entity applicable.

B. Refer also to the "Encyclopedia of Associations", published by Gale Research Co., available in most libraries.

C. The following are commonly used abbreviations which may be found on Contract Drawings and in Contract Specifications:
REFERENCES

01/10 Edition; Rev. 0
REFERENCES

01/10 Edition; Rev. 0

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>MM</td>
<td>State of California, Business and Transportation Agency, Department of Transportation, &quot;Materials Manual&quot;</td>
</tr>
<tr>
<td>MSS</td>
<td>Manufacturers Standardization Society of the Valve and Fittings Industry</td>
</tr>
<tr>
<td>NAAMM</td>
<td>National Association of Architectural Metal Manufacturers</td>
</tr>
<tr>
<td>NEC</td>
<td>National Electrical Code</td>
</tr>
<tr>
<td>NECA</td>
<td>National Electrical Contractors Association</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Electrical Manufacturers Association</td>
</tr>
<tr>
<td>NFC</td>
<td>National Fire Code</td>
</tr>
<tr>
<td>NFPA</td>
<td>National Fire Protection Association</td>
</tr>
<tr>
<td>NFPA</td>
<td>National Fire Sprinkler Association</td>
</tr>
<tr>
<td>NGA</td>
<td>National Glass Association</td>
</tr>
<tr>
<td>NIBS</td>
<td>National Institute of Building Sciences</td>
</tr>
<tr>
<td>NIST</td>
<td>National Institute of Standards and Technology</td>
</tr>
<tr>
<td>NPCA</td>
<td>National Precast Concrete Association</td>
</tr>
<tr>
<td>NRCA</td>
<td>National Roofing Contractors Association</td>
</tr>
<tr>
<td>NSC</td>
<td>National Safety Council</td>
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<tr>
<td>NSF</td>
<td>National Sanitation Foundation</td>
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<tr>
<td>NSPE</td>
<td>National Society of Professional Engineers</td>
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<tr>
<td>NTMA</td>
<td>National Terrazzo and Mosaic Association</td>
</tr>
<tr>
<td>NWMA</td>
<td>National Woodwork Manufacturers Association</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
</tr>
<tr>
<td>OSHPD</td>
<td>Office of Statewide Health Planning and Development (State of California)</td>
</tr>
<tr>
<td>PCA</td>
<td>Portland Cement Association</td>
</tr>
<tr>
<td>PCI</td>
<td>Precast/Prestressed Concrete Institute</td>
</tr>
<tr>
<td>PDCA</td>
<td>Painting and Decorating Contractors of America</td>
</tr>
<tr>
<td>PDI</td>
<td>Plumbing and Drainage Institute</td>
</tr>
<tr>
<td>PS</td>
<td>Product Standard (U.S. Department of Commerce)</td>
</tr>
<tr>
<td>RIS</td>
<td>Redwood Inspection Service</td>
</tr>
<tr>
<td>SDI</td>
<td>Steel Deck Institute</td>
</tr>
<tr>
<td>SFM</td>
<td>State Fire Marshal (California)</td>
</tr>
<tr>
<td>SFPE</td>
<td>Society of Fire Protection Engineers</td>
</tr>
<tr>
<td>SGCC</td>
<td>Safety Glazing Certification Council</td>
</tr>
<tr>
<td>SIGMA</td>
<td>Sealed Insulating Glass Manufacturers Association</td>
</tr>
<tr>
<td>SJI</td>
<td>Steel Joist Institute</td>
</tr>
<tr>
<td>SMACNA</td>
<td>Sheet Metal and Air Conditioning Contractors National Association</td>
</tr>
<tr>
<td>SSPC</td>
<td>Society for Protective Coatings (Steel Structure Painting Council)</td>
</tr>
<tr>
<td>SSPWPC</td>
<td>Standard Specifications for Public Works Construction</td>
</tr>
<tr>
<td>SWRI</td>
<td>Sealant, Waterproofing and Restoration Institute</td>
</tr>
<tr>
<td>TCA</td>
<td>Tile Council of America</td>
</tr>
<tr>
<td>UBC</td>
<td>Uniform Building Code</td>
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<tr>
<td>UFC</td>
<td>Uniform Fire Code</td>
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<tr>
<td>UL</td>
<td>Underwriters Laboratories, Inc.</td>
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<tr>
<td>UMC</td>
<td>Uniform Mechanical Code</td>
</tr>
<tr>
<td>UPC</td>
<td>Uniform Plumbing Code</td>
</tr>
<tr>
<td>USS</td>
<td>United States Standard</td>
</tr>
<tr>
<td>WCCLIB</td>
<td>West Coast Lumber Inspection Bureau</td>
</tr>
<tr>
<td>WIC</td>
<td>Woodwork Institute of California</td>
</tr>
<tr>
<td>WWPA</td>
<td>Western Wood Products Association</td>
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</tbody>
</table>

D. Words and terms not otherwise specifically defined in this Section or in the Contract Documents, shall be as customarily defined by trade or industry practice, by reference standard and by specialty dictionaries such as Dictionary of Architecture and Construction (Cyril M. Harris, McGraw-Hill Professional; 3rd Edition, February 18, 2000) and AIA Document M101, Glossary of Construction Industry Terms.

E. Additional abbreviations, used on the Drawings, are listed thereon.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 42 00
SECTION 01 45 00
QUALITY CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Contractor's Quality Control
B. Quality of the Work
C. Inspections and tests by governing authorities
D. Inspections and tests by serving utilities
E. Inspections and tests by manufacturer's representatives
F. Inspections and Independent testing and Inspection Laboratories/Agencies
G. Contractor responsibilities in inspections and tests
H. Contractor responsibilities regarding UCDMC testing laboratory
I. Test reports
J. Geotechnical engineer

1.2 RELATED SECTIONS

A. Section 01 31 00 – COORDINATION
B. Section 01 41 00 – REGULATORY REQUIREMENTS: Compliance with applicable codes, ordinances and standards.
C. Section 01 45 23 – INSPECTION OF WORK
D. Section 01 60 00 – PRODUCT REQUIREMENTS: Product Options, substitutions, transportation and handling requirements, storage and protection requirements, and system completeness requirements.

1.3 CONTRACTOR'S QUALITY CONTROL

A. Contractor's Quality Control: Contractor shall ensure that products, services, workmanship and site conditions comply with requirements of the Contract Documents by coordinating, supervising, testing and inspecting the Work and by utilizing only suitably qualified personnel.

B. Quality Requirements: Work shall be accomplished in accordance with quality requirements of the Contract Documents, including, by reference, all Codes, laws, regulations and standards. When no quality basis is prescribed, the quality shall be in accordance with the best-accepted practices of the construction industry for the locale of the Project, for projects of this type.
C. Quality Control Personnel: Contractor shall employ and assign knowledgeable and skilled personnel as necessary to perform quality control functions to ensure the Work is provided as required.

1.4 QUALITY OF THE WORK

A. Quality of Products: Unless otherwise indicated or specified, all products shall be new, free of defects and fit for the intended use.

B. Quality of Installation: All Work shall be produced plumb, level, square and true, or true to indicated angle, and with proper alignment and relationship between the various elements.

C. Protection of Completed Work: Take all measures necessary to preserve completed Work free from damage, deterioration, soiling and staining, until Acceptance by University.

D. Standards and Code Compliance and Manufacturer's Instructions and Recommendations: Unless more stringent requirements are indicated or specified, comply with manufacturer's instructions and recommendations, reference standards and building code research report (ICC) requirements in preparing, fabricating, erecting, installing, applying, connecting and finishing Work.

E. Deviations from Standards and Code Compliance and Manufacturer's Instructions and Recommendations: Document and explain all deviations from reference standards and building code research report requirements and manufacturer's product installation instructions and recommendations, including acknowledgement by the manufacturer that such deviation is acceptable and appropriate for the Project.

F. Verification of Quality: Work shall be subject to verification of quality by University's Representative and University's Consultant in accordance with provisions of the General Conditions of the Contract.

1. Contractor shall cooperate by making Work available for inspection by University's Representative, University's Consultant or their designated representatives.

2. Such verification may include mill, plant, shop, or field inspection as required.

3. Provide access to all parts of the Work, including plants where materials or equipment are manufactured, fabricated or stored.

4. Provide all information and assistance as required, including that by and from subcontractors, fabricators, materials suppliers and manufacturers, for verification of quality by University’s Representative or University’s Consultant.

5. Contract modifications, if any, resulting from such verification activities shall be governed by applicable provisions in the General Conditions of the Contract.

G. Observations by University's Consultants: Periodic and occasional observations of the Work in progress will be made by University's Consultant and their consultants as deemed necessary to review progress of Work and general conformance with design intent.
H. Limitations on Inspections, Tests and Observations: Neither employment of independent testing and inspection agencies nor observations by University's Consultant and their consultants shall relieve Contractor of obligation to perform Work in full conformance to all requirements of Contract Documents.

I. Acceptance and Rejection of Work: University's Representative reserves the right to reject all Work not in conformance to the requirements of the Contract Documents.

1. If initial tests or inspections made by University's Testing Laboratory or University's Geotechnical Engineer reveal any portion of the Work fails to comply with Contract Documents, or if it is determined that any portion of Work requires additional testing or inspection, additional tests and inspections shall be made as directed by University's Representative.

2. If such additional tests or inspections establish such portions of the Work comply with Contract Documents, all costs of such additional testing or inspection will be paid by University.

3. If such additional tests or inspections establish such portions of the Work fail to comply with Contract Documents, all costs of such additional tests and inspection shall be deducted from the Contract sum.

J. Correction of Non-conforming Work: Non-conforming Work shall be modified, replaced, repaired or redone by Contractor at no change in the Contract Sum or Contract time.

K. Acceptance of Non-Conforming Work: Acceptance of non-conforming Work, without specific written acknowledgement and approval of University shall not relieve Contractor of the obligation to correct such Work.

L. Contract Adjustment for Non-conforming Work: Should University or University's Consultants determine it is not feasible or in University's interest to require non-conforming Work to be repaired or replaced, an equitable reduction in Contract Sum shall be made by agreement between University and Contractor. If equitable reduction in Contract Sum cannot be agreed upon, a Directed Change Order will be issued and the amount in dispute resolved in accordance with applicable provisions of the General Conditions of the Contract.

1.5 INSPECTIONS AND TESTS BY GOVERNING AUTHORITIES

A. Regulatory Requirements for Testing and Inspection: Comply with California Building Code (CBC) requirements and all other requirements of governing authorities having jurisdiction.

B. Inspections and Tests by governing Authorities: Contractor shall cause all tests and inspections required by governing authorities having jurisdiction to be made for Work under this Contract.

1. Such authorities include University's Building Inspection (code compliance), University's Fire Department (SFM) and similar agencies.

1.6 INSPECTIONS AND TESTS BY SERVING UTILITIES

A. Inspections and Tests by Serving Utilities: Contractor shall cause all tests and inspections required by serving utilities to be made for Work under this Contract. Scheduling, conducting and paying for such inspections shall be solely the Contractor's responsibility.
1.7 INSPECTIONS AND TEST BY MANUFACTURER'S REPRESENTATIVES

A. Inspections and Tests by Manufacturer's Representatives: Contractor shall cause all tests and inspections specified to be conducted by materials or systems manufacturers, to be made. Additionally, all tests and inspections required by materials or systems manufacturers as condition of warranty or certification of Work shall be made, the cost of which shall be included in the Contract Sum.

1.8 INSPECTION BY INDEPENDENT TESTING AND INSPECTION LABORATORIES

A. Definitions:

1. The term "University's Testing Laboratory" means a testing laboratory retained and paid for by University for the purpose of reviewing material and product reports, performing material and product testing and inspection, and other services as determined by University.

B. University will select an independent testing and inspection laboratory or agency to conduct tests and inspections as called for in the Contract Documents and as required by governing authorities having jurisdiction.

1. Responsibility for payment for tests and inspection shall be as indicated in the schedule below. All time and costs for Contractor's services related to such tests and inspections shall be included in Contract Time and Contract Sum.

C. Contractor shall notify University, and if directed by University's Representative testing and inspection laboratory, when Work is ready for specified tests and inspections.

D. Contractor shall pay for all additional charges by testing and inspection agencies and governing authorities having jurisdiction due to the following:

1. Contractor's failure to properly schedule or notify testing and inspection agency or authority having jurisdiction.

2. Changes in sources, lots or suppliers of products after original tests or inspections.

3. Changes in means, methods, techniques, sequences and procedures of construction that necessitate additional testing, inspection and related services.

4. Changes in mix designs for concrete and mortar after review and acceptance of submitted mix design.

E. Test and inspections shall include, but not be limited to, the following:

List the applicable services required, for example:

<table>
<thead>
<tr>
<th>Material Inspection/Tests</th>
<th>Paid by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Reinforcement</td>
<td>University</td>
</tr>
<tr>
<td>Cast In Place</td>
<td>University</td>
</tr>
<tr>
<td>Structural Steel</td>
<td>University</td>
</tr>
<tr>
<td>Reinforcement Inspection</td>
<td>University</td>
</tr>
<tr>
<td>Reinforcement Strength</td>
<td>University</td>
</tr>
<tr>
<td>Slump Tests</td>
<td>University</td>
</tr>
<tr>
<td>Compressive Strength Tests</td>
<td>University</td>
</tr>
<tr>
<td>Welding Inspection</td>
<td>University</td>
</tr>
<tr>
<td>High-strength Bolting Inspection</td>
<td>University</td>
</tr>
</tbody>
</table>
F. Test and Inspection Reports: After each inspection and test, one (1) copy of report shall be promptly submitted to University's Representative, Contractor and to agency having jurisdiction (if required by code).

1. Reports shall clearly identify the following:
   a. Date issued.
   b. Project name and A/C number.
   c. Identification of product and Specification Section in which Work is specified.
   d. Name of inspector.
   e. Date and time of sampling or inspection was conducted.
   f. Location in Project where sampling or inspection was conducted.
   g. Type of inspection or test.
   h. Date of tests.
   i. Results of tests.
   j. Comments concerning conformance with Contract Documents and other requirements.

2. Test reports shall indicate specified or required values and shall include statement whether test results indicate satisfactory performance of products.

3. Samples taken but not tested shall be reported.

4. Test reports shall confirm that methods used for sampling and testing conform to specified test procedures.

5. When requested, testing and inspection agency shall provide interpretations of test results.

6. Verification reports shall be prepared and submitted, stating tests and inspections specified or otherwise required for Project, have been completed and material and workmanship comply with the Contract Documents. Verification reports shall be submitted at intervals not exceeding six (6) months, at Substantial Completion of the Project, and at all times when Work of Project is suspended.

1.9 CONTRACTOR RESPONSIBILITIES IN INSPECTIONS AND TESTS

A. Tests, inspections and acceptances of portions of the Work required by the Contract Documents or by Applicable Code Requirements shall be made at the appropriate times. Except as otherwise provided, Contractor shall notify University's Representative to make arrangements for such tests, inspections and acceptances. Contractor shall give University's Representative timely notice of all required inspections as outlined in Specification Section 01 45 23 – INSPECTION OF WORK, Item 1.5, Scheduling Inspections – Notification Requirements.
B. If such procedures for testing, inspection or acceptance reveal failure of any portion of the Work to comply with requirements of the Contract Documents, Contractor shall bear all costs made necessary by such failure including those of repeated procedures, including compensation for University's Consultant's services and expenses.

C. If University and/or University's Consultants are to observe tests, inspections or make acceptances required by the Contract Documents, University and/or University's Consultant will do so promptly and, where practicable, at the normal place of testing.

D. Cooperate with testing and inspection agency personnel, University, University's Consultant's and their consultants. Provide access to Work areas and off-site fabrication and assembly locations, including during weekends and after normal work hours.

E. Provide incidental labor and facilities to provide safe access to Work to be tested and inspected, to obtain and handle samples at the Project site or at source of products to be tested, and to store and cure test samples.

1.10 CONTRACTOR RESPONSIBILITIES REGARDING UCDMC TESTING LABORATORY

A. Secure and deliver to University's Testing Laboratory adequate quantities of representative samples of materials proposed for use as specified.

B. Submit to University's Representative the preliminary design mixes proposed for concrete and other materials, which require review, by University's Consultants and/or University's Testing Laboratory.

C. Submit copies of product test reports as specified.

1.11 TEST REPORTS

A. University's Testing Laboratory shall submit one (1) copy of all reports to University's Representative, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

B. University will distribute one (1) copy of the reports to University's Consultants and Contractor.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 45 00
SECTION 01 45 10
SEISMIC CONTROL – OSHPD

PART 1 GENERAL

1.1 DESCRIPTION

A. Provide all required seismic restraints and calculations in order to insure that the installation of all architectural, mechanical, and electrical equipment/components are in compliance with all applicable seismic codes, standards, and specific information listed herein.

1.2 QUALITY ASSURANCE

A. ASTM standards
B. 2013 California Building Code, Title 24 (CBC)

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s technical product data and installation instructions for each type of material listed in this Section.

B. Submit special seismic certification (OSP) for mechanical and electrical equipment/components as noted on CBC 1705A.12.4. Contractor shall bear all costs associated with any and all tests, engineering calculations and documentation required to obtain OSHPD approval in accordance with this section in a timely manner if the Contractor chooses to select equipment that does not already have special seismic certification as noted on the design documents.

C. Submit OSHPD Pre-approved Manufacturer’s Certification (OPM) as noted on the design drawings.

PART 2 PRODUCTS

2.1 SEISMIC RESTRAINT REQUIREMENTS

A. SUMMARY

1. This section covers the seismic restraint requirements for suspended vibration and non-vibration isolated items, systems and/or related suspended equipment.

2. The designers of record as referenced in this specification shall be the project architect, structural engineer and the appropriate system engineer (e.g., electrical, etc.).

3. OSHPD OPM shall be considered the specified seismic design for this project. Other designs may be submitted as an alternate provided they meet or exceed all of the requirements contained within these specifications, and provided they meet or exceed all of the OSHPD pre-approved service loads, installation applications, engineering services, etc. Furthermore, other OSHPD pre-approved designs must be submitted to the designers of record for review and acceptance, and to OSHPD as a deferred approval prior to installation, with all costs including but not limited to project delay costs, to be borne by the contractor.

B. SEISMIC RESTRAINT DESIGN

1. The attachment, supports and seismic restraints of suspended non-structural components and distribution systems listed below shall be designed to resist the total design seismic forces prescribed in the CBC.
a. All equipment/components including but not limited to: electrical, mechanical, plumbing, and architectural.

b. Without referencing OPM or OSHPD approved seismic attachment and supports shown on the design document, seismic support and attachment shall be engineered and built by the applicable system contractor. Engineering shall be (signed & sealed) by a licensed California Structural Engineer and submitted to the designers of record and OSHPD for acceptance prior to installation. Cost to be borne by the contractor.

c. Design and installation shall consider seismic relative displacement in accordance with ASCE 7-10 – 13.3.2.

2. Seismic restraint transverse and/or longitudinal spacing shall not exceed CBC requirements and the lesser of the following:

a. That which develops seismic design forces equal to or less than the capacity of the building structure.

b. That which develops seismic design forces that are equal to or less than the capacity of weakest part, component, anchorage, etc., contained within the seismic brace assembly.

c. 40’ feet transversely and/or 80’ feet longitudinally where pipes, conduits, and their connections are constructed of ductile materials (copper, ductile iron, steel or aluminum and brazed, welded or screwed connections).

d. 20’ feet transversely and/or 40’ feet longitudinally where pipes, conduits, and their connections are constructed of nonductile materials (e.g., cast iron, no-hub pipe and plastic).

e. 20’ feet transversely and/or 40’ feet longitudinally for bus ducts and cable trays, baskets, channels.

3. Contractor shall not adopt, use or otherwise implement the omission of any seismic restraints without prior review and acceptance by the designers of record. Submittals for omission of seismic restraints shall be limited to piping, ducts and conduits. All submittals for omission of seismic restraints must include the following, and must be (signed & sealed) by a licensed California Structural Engineer and approved by OSHPD:

a. Project specific cover letter clearly indicating that said engineer has (with respect to the attached submittal for omission of seismic restraints) completely review the project documents including these specifications, the items/systems designs individually and in coordination with all other trades, and that all code and/or project specified requirements for omission of restraints have been meet individually and in combination with each other, that (if the attached submittal for omission is approved) said engineer has been hired/retained by contractor to visit the project site without limit to review and inspect the installation of the items/systems which have been reviewed and approved for installation without seismic restraints.

b. Engineered details and engineering for all vertical supports and their connections to the building structure to qualify, that top connections can not develop moments, that lateral motion will not cause loss of item/system support, that lateral motion of the item/system will not cause damaging impact with other items/systems, that lateral motion of the item/system will not directly or indirectly impact any life safety, emergency services and/or hazardous items/systems or their supports.

4. Seismic hardware brackets shall provide a (Captive) 360-degree connection that completely encloses or encircles the rod, anchor, bolt, fastener, etc. Open hook and/or open slot seismic hardware brackets shall not be allowed.

5. Seismic restraint assembly connections shall not incorporate the use of break-off bolts or nuts and pneumatic fasteners.

6. Seismic restraint cables shall be looped through the seismic hardware bracket and turned back onto itself at the point of assembly/connection. Cables shall not be installed or attached to the seismic hardware bracket in a straight through (non turn back) method of assembly/connection.
7. Seismic hardware brackets, connectors and related components shall be constructed entirely of malleable iron or steel. Seismic assemblies shall not include the use of cast components.

8. Ceiling and other types of single strand wire shall not be used as a seismic restraint, sway brace and/or safety restraint material.

9. The connection to the building structure of non-seismic sway bracing and/or safety restraints shall meet or exceed that required for the attachment of seismic restraints to the building structure.

10. Seismic restraints shall be installed to provide a minimum of (2) transverse and (1) longitudinal braces per run. A “run” shall be defined as a length of 5′ feet or more.

11. The accumulated load of multiple items to any given support (with or without seismic restraints) shall be limited so as not to overload the building structure and the support assembly.

12. Pipes, conduits, and other items attached to trapeze hangers shall be located above each individual trapeze hanger so that the accumulated load is evenly distributed.

13. Trapeze systems installed in a multi-layer configuration shall have seismic restraints designed and installed for each individual trapeze layer.

14. Vertical supports shall be designed and installed to account for vertical tension and compression loads including accumulated seismic component increases.

15. Vertical supports, single hanger, trapeze hangers and their clamps, clips and methods of connection shall be constructed of ductile materials (e.g., copper, ductile iron, or steel).

16. Do not use insulation inserts (e.g., cal-sil, metal, etc.) at seismic brace connection locations without prior written approval from the structural engineer. Do not connect seismic bracing to insulation inserts without prior written approval from the structural engineer.

17. Design of supports, seismic restraints and anchorage to the structure shall consider all conditions that involve thermal, structural separation, relative displacement, building expansion and contraction.

18. Use following criteria for seismic bracing of electrical conduits:
   
   a. Wherever combined weights of multiple conduits plus contents on a trapeze equals or exceeds the weight of a single 2-1/4" conduit plus contents, design trapeze system per ASCE 7-10, Chapter 13, and brace in accordance with NUSIG/Badger Industries.

19. The following conduit plus contents weight data may be used for EMT in lieu of SMACNA guidelines:

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<td>½</td>
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20. Weight per trapeze support assembly must be calculated from above table and spacing between support assemblies.
21. For assemblies carrying less than 320 LB., down to equivalent of a single 2-½” conduit plus contents, use 320 LB criteria or submit alternate details for approval.

22. All single conduits 2-½” and larger shall be designed per ASCE 7-10, Chapter 13, and braced in accordance with these guidelines and OPM or engineered details.

23. SMACNA details shall not be used without prior approval by Structural Engineer of Record (SEOR).

C. ACCEPTABLE MANUFACTURERS

1. OSHPD Pre-approved Certified Manufacturer (OPM)

D. ANCHORS, INSERTS AND FASTENERS

1. All anchors, inserts, fasteners or connections to the structure shall be submitted to the structural engineer of record for review and acceptance prior to installation.

2. Do not use any anchor or insert in concrete or metal decking with concrete fill, which does not have a signed structurally engineered design value based on its installed application and one of the following:
   a. ICC evaluation report
   b. OSHPD pre-approved

3. Cast-in-place inserts used in concrete or metal decking with concrete fill, shall be constructed entirely of malleable iron or steel.

4. Cast-in-place inserts that contain internal threads shall include the installation of a jam or lock nut to secure the connection of the vertical support rod to the cast-in-place insert.

5. Cast-in-place inserts that allow for horizontal adjustment shall not be allowed, unless an engineered solution is provided to assure positive captive positioning and securement of the attachment.

6. Do not use powder driven and power driven (Shoot-In) fasteners, expansion nails or internally threaded anchors in concrete or metal decking with concrete fill without prior approval of the Project Manager.

7. All beam clamps shall be constructed of malleable iron or steel. All single flange mounted beam clamps shall include a retaining strap or J-hook and must be submitted to the project structural engineer of record for review and acceptance prior to installation. Beam clamps shall not be used to resist seismic loads.

E. FIELD QUALITY CONTROL

1. Inspection of seismic restraints by the Inspector of Record (IOR), and/or Authority Having Jurisdiction (AHJ).

2. Make all corrections recommended by the designers of record after approval by the University and OSHPD.

PART 3 EXECUTION

3.1 SEISMIC ANCHORING AND RESTRAINTS

A. Equipment anchors:

1. All equipment shall be anchored. Anchor equipment per details shown on the drawings where provided.

2. Anchor installation shall be in accordance with the current ICC report.

3. Anchor details provided are based on specific equipment information. Submit design for approval for anchoring of equipment which varies from design.
B. Conduit supports:
   1. Conduits shall be supported and braced per CBC Title 24.

C. Lighting fixture supports:
   1. Provide independent seismic support system for all lighting fixtures.

D. Minimum clearance:
   1. Diagonal braces and hanger supports shall maintain 6 inches minimum clearance from
   unbraced ducts and conduits, and 1 inch minimum clearance from braced ducts and
   conduits.

3.2 INSTALLATION AND TESTING OF MECHANICAL ANCHORS:

A. Where permitted in other Sections of this specification, drilled-in expansion-type anchors or other
post-installed concrete anchors may be used in hardened concrete.

B. All post-installed concrete anchors shall be tested. Testing shall be performed in the presence of
the Inspector of Record. Number of anchors to be tested shall be as shown on the drawings with
a minimum of 50% of anchors installed and at each support. Testing shall be performed by torque
or pull test, and to the values noted on the drawings. Test loads, frequency and acceptance
criteria of post-installed anchors in concrete shall be in accordance with CBC 1913A.7.

C. Internally threated shell-type anchors and displacement controlled anchors (e.g., dropin anchors,
screw anchors, adhesive anchors, etc.) shall not be tested using a torque wrench.

D. Screw anchors shall be installed with a calibrated torque wrench and may be loosened a
maximum of one full turn to facilitate the positioning of a tension test collar. Following the tension
test, the anchor shall be re-torqued in accordance with the manufacturer’s installation
instructions.

E. Tension test of chemical/adhesive anchors and power actuated fasteners shall be in accordance
with CBC, Title 24, and as noted on the drawings.

F. All testing procedures shall be in accordance with CBC 1913A.7, and as noted on the drawings.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Project Inspections and Procedures
B. Scheduling Inspectors – Notification requirements

1.2 RELATED SECTIONS

A. Section 01 31 00 – COORDINATION
B. Section 01 32 00 – CONTRACT SCHEDULES
C. Section 01 35 00 – SPECIAL PROCEDURES
D. Section 01 41 00 – REGULATORY REQUIREMENTS
E. Section 01 45 00 – QUALITY CONTROL

1.3 DEFINITIONS

A. IOR: Inspector-of-Record
B. ACO: Area Compliance Officer for OSHPD
C. DSE: District Structural Engineer for OSHPD
D. FM: Fire Marshal (may include both OSHPD FM and State FM)
E. TL: Testing Laboratory

1.4 PROJECT INSPECTIONS AND TESTING PROCEDURES

A. Inspections: This Project is under the jurisdiction of the Office of Statewide Health Planning and Development. The following inspections will be requested on this project, as appropriate. Also see Part 3 for non-OSHPD inspection items or Part 3, Item 3.12 for OSHPD requirements.

1. Reinforcing Bar inspections prior to placement of concrete
2. Concrete placement inspection
3. Wall framing inspection
4. Wall close-in inspection
5. Gypsum board installation inspection
6. Mechanical rough-in inspection
7. Electrical rough-in inspection
8. Above ceiling fire and seismic bracing and support inspections
9. Fire-stop and Fire-caulk penetration inspection
10. Fireproofing inspection
11. Fire alarm, fire sprinkler testing and inspections
12. Fire Damper inspections
13. Seismic bracing and post-installed anchor bolt inspections for all mechanical, electrical, low voltage and specialty systems.
14. Final inspections

B. Procedures: University’s Representative shall be the Contractor’s contact for all inspection requests. Contractor shall fill out Inspection Request Form for all inspections.

1. Contractor shall properly plan and coordinate inspection requests. Schedule delays caused by Contractor’s failure to plan and/or coordinate inspection requests will not be considered for adjustments to Contract Time or Contract Sum.

2. A complete set of OSHPD/SFM stamped and approved Contract Drawings and Contract Specifications, including applicable shop drawings and building permit shall be available on site for review by the Inspector-of-Record. The Contractor, Subcontractors and other responsible parties shall be present during inspection walk-throughs. All areas of project scope shall be ready and accessible for inspection. Contractor shall provide access equipment as applicable for the inspector’s needs.

1.5 SCHEDULING INSPECTIONS – NOTIFICATION REQUIREMENTS

A. Advance Inspection Notification: University’s Representative for this project requires the following advance notifications to schedule appropriate inspection agencies at the project site.

1. IOR Inspection Request Notification: Twenty-four (24) hours. Note: Inspection requests received by 2:00 PM will be scheduled for next day inspection. Inspection requests received after 2:00 PM will be scheduled for the following day; (example: Inspection request received at 2:01 PM on a Monday would be scheduled for inspection on Wednesday). Weekend and off-hours inspection requests will be scheduled on a case-by-case basis with a minimum of seventy-two (72) hour inspection request notification.

2. OSHPD Field Compliance Inspectors: Fourteen (14) calendar days.

3. Testing Laboratory Inspections: Twenty-four (24) hours.

a. All testing laboratory and testing procedures must be scheduled by University’s Representative. Inspections and/or testing directly scheduled by Contractor will not be accepted.
b. Contractor will bear all costs associated with unauthorized inspections and testing.

4. State Fire Marshal Inspection request Notification: Seventy-two (72) hours.

**B. Methods of Inspection Notification:**

1. All inspection notifications shall be in writing using inspection forms located at back of this Section. Incomplete forms will be returned as non-compliant and no inspection will be scheduled until all required inspection information is provided.

2. Faxed inspection requests will be accepted. University's Representative fax number is 916-734-1375 notification time begins from date stamp of University's fax machine. Faxed notification requests received after normal business hours and/or received on non-normal workdays, as defined in Specification Section 01 31 00 – COORDINATION, paragraph 1.7.F.4.A will begin notification time starting at 7:00 AM the following normal business day.

3. Emailed inspection requests will be accepted. University's Representative email address is fdc.inspectors@ucdmc.ucdavis.edu. Notification time begins from the date and stamp of the email, provided it is sent during normal business hours. Emailed inspection requests sent after normal business hours and/or received on non-normal workdays, as defined in Specification Section 01 31 00 – COORDINATION, paragraph 1.7.F.4.A will begin notification time starting at 7:00 AM the following normal business day.

**C. Off-hours Inspection Requests:** Contractor shall provide time windows for all off-hour or other than normal work hour inspections. University's Representative shall have final authority in setting times of off-hour inspections.

**D. Re-inspections:**

1. More then two (2) re-inspections: The cost of re-inspections of the same work, more than twice, shall be deducted from Contract Sum. IOR's hourly rates are $115.00 per hour during normal work hours and $150.00 per hour for all off-hour inspections. University will provide itemized invoice for Contractor's records.

2. Work unprepared for inspection: Re-inspections of the same work scheduled by Contractor, but not ready for inspection will be identified as a re-inspection.

**PART 2 - PRODUCTS – Not Applicable to this Section**

**PART 3 - EXECUTION**

Note: Part 3 describes typical inspection requirements for each individual inspector's jurisdiction for non-OSHPD projects. Part 3 is provided as a reference source for Contractor's use and Scheduling, as applicable. Part 3 is not intended to be all-inclusive and Contractor shall verify actual inspection requirements needed for this project. See Item 3.12 for Testing, Inspection Observation for OSHPD.

3.1 FIRE DAMPERS (Title 24, Part 2, Chapter 43)

Note: Manufacturer's installation instructions shall be used for inspections and testing.

A. 1 Hour: IOR test 100%. State Fire Marshal tests 100% or as needed.
B. 2 Hour: IOR tests 100%. State Fire Marshal tests 100%.
C. Smoke: IOR tests 100%. State Fire Marshal tests 100%.

3.2 FIRE SPRINKLERS (Title 24, Part 2, Volume 1, Chapter 9; NFPA Bulletin 13)
A. Approved drawings shall be on job-site from start to completion of project.
B. Underground pressure test @ 200 psi.
C. State Fire Marshal to witness installation of underground lines.
D. State Fire Marshal to witness underground flush prior to connection.
E. Hydro-test above ground piping @ 200 psi for two (2) hours.
F. Inspection of hangers, bracing, and seismic joint crossing(s).
G. Flow alarm test, tamper switch test.
H. Fire pump test.
I. Certification by installer (Title 24, Part 9, Article 1006.3.4.2).
J. Final inspection: signs in place, labeling, fire extinguishing system flow alarm test.

3.3 FIRE ALARM SYSTEM (Title 24; Part 9, Article 1006)
Note: Fire Sprinkler and Fire Alarm systems tests shall be performed in presence of State Fire Marshal.
A. Approved drawings shall be on job-site from start to completion of project.
B. Verify Emergency Power source.
C. Activate all initiating devices.
D. Certification by installer (Title 24, Part 9, Article 1006.3.4.2).
E. Complete test of system per Title 24, Part 9, CFC, Article 1003.3.4.1).

3.4 MEANS OF EGRESS (Title 24, Part 2, Volume 1, Chapters 10)
A. Exit sign/light locations and connected to two (2) sources of power.
B. Normal Power.
D. Construction - floors, walls, ceilings, penetrations per listings.
E. Electrical boxes - no back to back, 24 inches horizontal separation (Section 709).
F. Electrical boxes - 100+ square inches to be wrapped/protected.
G. Flame Spread, Fuel Contribution and Smoke Density for finishes (Chapter 8).

3.5 FIRE WALL/FLOOR/CEILING PENETRATION ASSEMBLIES (Title 24, Part 2, Volume 1, 700 and 710)

A. Fire-stopped per Title 24, Part 2, Volume 1, Section 708.

B. Listed by an Approved Agency.

C. Fireproofing (Section 704.6, Testing UBCC Standard 7.6).

3.6 EMERGENCY LIGHTING

A. Generator Test (Title 24, Part 3, Section 700-4; Section 701-5).

B. Emergency lights - locations (Title 24, Part 2, Volume 1, Chapter 10, Section 1003.2.8.5).

3.7 MECHANICAL CHECKLIST FOR CLOSE-OUT (Title 24, Part 4)

A. Mechanical Equipment Requirements

1. Access to Equipment (Section 305, 405, 606.5, 815, 2.2.8, 903, 910.8, 1106.3).

2. Labeling of Equipment (Section 307).

3. Identification of Equipment - Area or Space Served (Section 304.5).

B. Mechanical Testing

1. Air balance completed and reviewed by Mechanical Engineer-of-Record.

2. Hospitals (Chapter 3, Section 314.1, Table 2110-A).

3. Skilled Nursing (Chapter 3, Section 314.2) [test to include humidity controls in required areas - Section 2102(a)].

4. Hydronic balance completed and reviewed by Mechanical Engineer-of-Record.

5. Air and Hydronic reports forwarded to Mechanical Engineer of Record.

6. Fuel Gas line inspection (Part 4, Section 1406 and Appendix B, Chapter 16).

7. Atrium and/or Building Smoke Evacuation System (State Fire Marshal to witness).

C. Boilers

1. Boiler – Operating Adjustments and Instructions (Section 1022).

2. Boiler – Inspections and Tests (Section 1023).

3. Boiler – Clearances/Permits (Section 1005.0).

D. Ducts
1. Installation - Bracing (Part 4, Section 604.1.4)

2. Fire Damper test log from IOR (Part 4, Section 606.2).

3. Fire Damper test by State Fire Marshal (Part 4, Chapter 6, Section 606.2).

4. Smoke Damper and Detector test log from IOR (Including Duct Detector tests).

5. Smoke Damper and Detector by State Fire Marshal.

E. HVAC Unit Testing

1. Verify correct filter types and efficiencies.

2. Motor Rotation.

3. Condensate drain tests (Section 310).

4. Equipment shut down by smoke detectors (duct or space).

3.8 PLUMBING CHECKLIST FOR CLOSE-OUT (Title 24; Part 2, Chapter 29; Part 5)

A. Piping Systems (Title 24, Part 5)

1. Domestic Water Line Sterilization Test (Title 24, Part 2, Section 609.9; Title 22, Division 4, Chapter 16, Article 5).

2. Domestic Water System (hot, cold) Pressure test (Title 24, Part 5, 609.4).

3. Natural Gas Pressure Test (Title 24, part 5, Chapter 12, Section 1204).

4. Vent & Waste System Pressure test (Title 24, Part 5, 712.0).

5. Hydronic Water Pressure test (Title 24, Part 4 1201.2.8).

B. Water Heater Testing

1. Water Heater Temperature Test (Domestic/Patient) (105-120°F).

2. Water Heater Temperature Test (Kitchen) (180°F).


C. Medical Gas System Testing (NFPA 99, Chapter 4) (Witnessed by SFM).

1. Pressure test - 150 psig - Oxygen, Medical Air & Nitrous Oxide (4-3.4.1.2).

2. Pressure test - 200 psig - Nitrogen (4-5.1.3.4).

3. 24-hour pressure test - 60 psig - Vacuum system (4-10).

4. 24-hour pressure test - 20% over operating pressure [A-4.3.4.1.2 (b)(e)].
5. Alarm test for system [4-3.4.1.3 (d)].
6. Area Valves, location, labeled, alarms tested (4-4.1 & 4-5.1.4).
7. Laboratory testing affidavits - welding/brazing (4-6.2.3.3).
8. Verified Medical Air Quality - Installation and 24 hour later.
9. Certification of system (Purity, Cross Connection, Alarms, Etc.) [4.5].
10. Certification of Bulk System [NFPA 50 (Oxygen) & CGA G-8.1 (Nitrous Oxide)].
11. Approved drawings and documents for submittal to University's Representative for permanent records).

3.9 ELECTRICAL CHECKLIST FOR CLOSE-OUT (Title 24, Part 3, and Part 1, Chapter 7, Section 7-141, 7-149)

A. Main Panel/Service

2. Grounding test and Certification (250, 250-56).
3. Ground fault interrupt test adjustment and certification [230-95(c); 517-17(c)].
4. Emergency power transfer switch test (700-4).
5. Panel load balance.

B. Emergency Power and Standby Systems (Article 700 & 701) [Test Logs from IOR]

1. Emergency Generator testing and certification (701-5).
3. Lighting and Lighting Levels (517-22).
5. Exiting signs and lights [517-32(b), 517-42(b)].
6. Nurse and Staff Call [517-33(a)].
7. Fire Alarm (760).

C. General Electrical Requirements

1. Working space/Headroom [Table 110-26(a); 110-33; 110-34].
2. Circuits and lights tested (410-45).
3. Receptacle polarity and grounding [200-10(b)].
4. Isolated ground monitor test [517-160(b)].
5. Motor load current adjustment.


7. Identify circuits (Critical Care Areas) (517-19).

D. Miscellaneous Electrical Requirements

1. Test logs from Contractor and Inspector-of-Record.

2. Electrical Engineer-of-Record acceptance of system.

3. Owner In-Service training on Equipment.

4. Equipment Manuals and Instruction to Owner.

5. Warrantees and Equipment Certification.

6. As-Built/Record Drawings to Owner.

3.10 FIRE MARSHAL INSPECTION REQUIREMENTS

A. Framing Inspections

1. Structural members in fire-resistive construction.

2. Check fireproofing per approved design tested assembly description.

B. Fire-Rated Partition Locations

1. Check for stud and nailing/screwing spacing per approved design tested assembly description.

2. Check for fire blocking in combustible construction.

3. Check for rated door/window frame installation (manufacturer's installation instructions shall be available for review).

4. Check for electrical installation, for example; number and size of electrical boxes, panels, cabinets, etc.

5. Check hangers, seismic bracing for sprinkler piping installation, if applicable (this would be checked during overload pressure test inspection phase of sprinkler system).

C. Close-In Inspections

1. Check fire-blocking and draft stops in combustible construction.

2. Check gypsum board installation in accordance with approved design assembly description for rated assembly.

3. Check integrity of firewall construction where recessed cabinets, panels, excessive electrical/plumbing are installed.
4. Check fire damper installation (manufacturer's installation instructions shall be available for review). Fire Marshal will witness actuation of minimum 10% fire dampers installed and 100% in 2 hour or greater fire rated wall assemblies.

5. Check for through-penetrations and fire-stop systems in all walls or floor/ceiling assemblies.

D. Final Construction Inspections

1. Final project walk-through: Example, Emergency lighting will be tested to verify exit illumination of both interior and exterior, while generator (if applicable) is tested at same time.

3.11 OSHPD – Testing, Inspection and Observation

END OF SECTION 01 45 23
### INSPECTION REQUEST

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<th>UCDHS IR #:</th>
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**To:** UC Davis Health System (UCDHS)

**From:** Facilities Design & Construction – Inspection Trailer

4430 V Street, Building 35-A

Sacramento, CA 95817

**P:** 916-734-5060

**F:** 916-734-1375

**Email:** fdc.inspectors@ucdmc.ucdavis.edu

**Attn.:**

**Drawing Ref.:**

**Detail:**

**Shop Drawing:**

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All work Requested for Inspection has been reviewed for compliance with the contract documents by Contractor’s Superintendent prior to notification of Inspection Request.

**Signed:**

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Inspection Request Notes or Description of Items of Deficiency if needed below (Part 1, Chapter 7, Section 7-145, item 6)

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**Project Field Record of Construction Progress Summary of Work in Progress (Part 1, Chapter 7, Section 7-145, item 6)**

**Project Phase (Building Foundation, Structural, Wall Framing, Electrical Rough-In, Sprinkler Rough-In, etc.):**

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**Project Phase Percentage Complete (% of the phase completed):**

<table>
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<th>Overall Project Percentage Complete:</th>
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# NON-CONFORMING WORK NOTICE

<table>
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<tr>
<th>A/C #:</th>
<th>OSHPD #:</th>
<th>Notice #:</th>
<th>Date:</th>
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</thead>
</table>

To: ____________________________  From: UC Davis Health System (UCDHS)

Facilities Design & Construction – Inspection Trailer

4430 V Street, Building 35-A

Sacramento, CA 95817

P: ____________________________  P: 916-734-5060

Email: ____________________________  Email: fdc.inspectors@ucdmc.ucdavis.edu

Attn.: ____________________________

---

Spec Section Ref.: ____________________________  Paragraph: ____________________________  Drawing Ref.: ____________________________

Detail:

---

In accordance with Article 12 of the General Conditions, the following defective condition(s) has/have become apparent:

---

Reported by: ____________________________

CORRECTIVE ACTION SHOULD BE TAKEN AS SOON AS POSSIBLE AND COMMENCE NO LATER THAN TEN (10) CALENDAR DAYS AFTER THIS NOTICE. COORDINATE THE VERIFICATION OF THE CORRECTIVE ACTIONS WITH THE INSPECTOR OF RECORD. IF FURTHER INFORMATION IS NEEDED, ADVICE UNIVERSITY’S REPRESENTATIVE IN ACCORDANCE WITH THE GENERAL CONDITIONS.

Description of corrective action taken:

---

Accepted by: ____________________________  Date: ____________________________

CC:
## Testing, Inspection and Observation Program

**2013 California Building Standards Code – OSHPD 1**

This program is prepared and submitted for an OSHPD 1 project. OSHPD 1 projects include all construction and remodel projects for general acute-care hospitals and acute psychiatric hospitals. OSHPD 1 projects also include construction and remodel of skilled nursing facilities and/or intermediate care facilities except those of single-story, Type V, wood or light steel-frame construction.

<table>
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<tr>
<th>A</th>
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<th>Facility Name: University of California Davis Medical Center</th>
<th>Project #: I140010-34-04</th>
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<tr>
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<tr>
<td>City: Sacramento</td>
<td>County: Sacramento</td>
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<td>Record Name (Scope of Project): UCDMC Hospital Seismic Upgrade Projects</td>
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### B) Tests - Documentation / Certification Required

<table>
<thead>
<tr>
<th>Structural Tests</th>
<th>Responsible Firm or Individual</th>
<th>*TBD</th>
<th>IOR</th>
<th>FDD Construction Acceptance</th>
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<tbody>
<tr>
<td>Compact fill</td>
<td>CBC 1705A.6 &amp; J107.5</td>
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<tr>
<td>Soil and rock anchors</td>
<td>CBC 1811A &amp; J106.2</td>
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<tr>
<td>Deep foundation elements</td>
<td>CBC 1810A.3.3.1.2, 1810A.3.1.5, 1810A.3.3.1.5, 1810A.3.3.2, &amp; 1810A.3.10.4</td>
<td>Load test</td>
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<td>Shoring</td>
<td>CBC J106.2</td>
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<td>Vibro Stone Columns (VSC)</td>
<td>CBC J112</td>
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<td>CBC 1705A.3, 1913A.1, ACI-318 3.1.2 &amp; 3.2</td>
<td>Cementitious materials</td>
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<td>CBC 1705A.3, 1903A.6, ACI-318 3.1.2 &amp; 3.3.1</td>
<td>Aggregates/Reactive aggregates</td>
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<td>CBC 1705A.3, ACI-318 3.1.2 &amp; 3.4</td>
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<td>CBC 1705A.3, ACI-318 3.1.2 &amp; 3.6</td>
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<td>CBC 1705A.3, 1904A.2, ACI-318 5.3 &amp; 5.4</td>
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<td>CBC 1705A.3, &amp; 1905A.1.2, ACI-318 5.6</td>
<td>Strength test</td>
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<td>Concrete</td>
<td>CBC 1705A.3, 1913A.2, &amp; ACI-318 3.5</td>
<td>Metal reinforcement (including welded wire fabric)</td>
<td>X</td>
<td>DSE:</td>
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</tbody>
</table>

*NOTE: To Be Determined (TBD) – The name of the firm or individual to perform this test or special inspection shall be submitted to and approved by the Office, prior to proceeding with the work that requires this test or special inspection.*
## Testing, Inspection and Observation Program

2013 California Building Standards Code - OSHPD 1

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<tr>
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<tbody>
<tr>
<td>CBC 1705A.3 &amp; ACI-318 3.5.5</td>
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<tr>
<td>Headed studs and headed stud assemblies</td>
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<thead>
<tr>
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<tbody>
<tr>
<td>CBC 1903A.8</td>
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<td>Welding of reinforcing bars</td>
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<td>CBC 1914A.2, ACI 503.7 Sec. 1.5</td>
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<td>Crack repair by epoxy injection</td>
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<td>CBC 2213A.1 &amp; 1705A.12.2</td>
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<td>High strength bolts, nuts, and washers</td>
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<td>CBC 2213A.2 &amp; 1705A.12.2</td>
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<td>End-welded studs</td>
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<td>CBC 1705A.12.2</td>
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<td>Buckling restrained brace (Load test)</td>
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<tr>
<td>Nondestructive weld test</td>
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Testing, Inspection and Observation Program
2013 California Building Standards Code – OSHPD 1

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<tr>
<td>CBC 1705A.12.4</td>
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<td>Prototype and production test</td>
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<td>CBC 104.11</td>
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<td>Tests to support alternative system</td>
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<tr>
<td>CBC 2410.1.2</td>
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<td>Structural sealant tests - Exterior glass curtain walls</td>
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<td>AAAMA 501.4 &amp; 501.6 tests - Ext. glass curtain walls</td>
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**ELECTRICAL TESTS**

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<tr>
<th>Conductor Insulation Resistance Test</th>
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<td>CEC 230.95(C) &amp; 517.17(D)</td>
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<td>CEC 240.12 &amp; CEC 700.27</td>
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**MECHANICAL TESTS**

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<td>CMC 1124.0</td>
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<td>CMC 1121.4 &amp; CFC 606.8</td>
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## Testing, Inspection and Observation Program

### 2013 California Building Standards Code – OSHPD 1

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<th>Steam and hot water boilers</th>
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**PLUMBING TESTS**

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# Testing, Inspection and Observation Program

2013 California Building Standards Code – OSHPD 1

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## FIRE PROTECTION EQUIPMENT TESTS

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**C** SPECIAL INSPECTIONS - DOCUMENTATION / CERTIFICATION REQUIRED

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<td>Manufacturer’s material mark inspection</td>
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| Concrete | CBC Table 1705A.3, Adhesive anchors in horizontal and upwardly inclined positions | X | DSE: |
| Concrete | CBC 1705A.3, Specialty inserts, Stud rails, Rebar mechanical conn., Headed rebar | | DSE: |
| Concrete | CBC 1705A.3, Reinforcing steel and prestressing steel | X | DSE: |
| Concrete | CBC 1705A.12.1, Concrete reinforcement for seismic resistance | | DSE: |
| Concrete | CBC 1705A.3.2, Batch plant inspection | | DSE: |
| Concrete | CBC 1705A.3.4, Prestressed concrete | | DSE: |
| Shotcrete | CBC 1705A.18 | | DSE: |
| Concrete | CBC 1705A.3, Insulating concrete | | DSE: |
| Concrete | CBC 1705A.2.2.1.2, 1903A.8, Welding of reinforcing bars | | DSE: |
| Concrete | CBC 1705A.3, Precast panels | | DSE: |
| Concrete | CBC 1705A.11.3, GFRC panels | | DSE: |
| Concrete | CBC 1914A.2, ACI 503.7 Sec. 1.5, Crack repair by epoxy injection | | DSE: |
| Concrete | CBC 1914A.3, ICC AC178 Sec. 3 to 8, Strengthening by externally bonded FRP | | DSE: |
| Masonry | CBC 1704A.5, Laying and grouting | X | DSE: |
| Masonry | CBC 2104A.5.1.1.2 & 2104A.5.1.2.2, Low lift grout | X | DSE: |
| Masonry | CBC 2104A.5.1.1.3 & 2104A.5.1.2.3, High lift grout | X | DSE: |
| Masonry | CBC 1704A.5, Masonry anchors | | DSE: |
| Steel | CBC 1705A.2 & 1705A.11.1, Steel shop fabrication | X | DSE: |
| Steel | CBC 1705A.2 & 1705A.11.1, Automatic end-welded stud | | DSE: |
| Steel | CBC 1705A.2 & 1705A.11.1, Shop and field welding | X | DSE: |
| Steel | CBC 1705A.2 & 1705A.11.1, High strength bolt installation | X | DSE: |

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# Testing, Inspection and Observation Program

## 2013 California Building Standards Code – OSHPD 1

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Responsible Individual</th>
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<th>FDD Construction Acceptance</th>
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<td>Steel</td>
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<td>CBC 1705A.11.8 Fabrication, installation, prototype, and production testing</td>
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<td>Aluminum</td>
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**MECHANICAL INSPECTIONS**

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<td>Visually inspect filter banks for torn media and bypass filter frames</td>
<td>CMC 408.1.3</td>
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<td>Process piping</td>
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**PLUMBING INSPECTIONS**

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<td>Fuel piping</td>
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### Testing, Inspection and Observation Program
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**Medical gas**
- NFPA 99-2012 Chapter 5
- Brazing and labeling of systems

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<tr>
<th>FIRE PROTECTION INSPECTIONS</th>
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**OTHER SPECIAL INSPECTIONS**

*NOTE: To Be Determined (TBD) – The name of the firm or individual to perform this test or special inspection shall be submitted to and approved by the Office, prior to proceeding with the work that requires this test or special inspection.*
## Testing, Inspection and Observation Program

**2013 California Building Standards Code – OSHPD 1**

### CONSTRUCTION OBSERVATION AND REPORTING

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<th>GEOR</th>
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**VERIFIED COMPLIANCE REPORT REQUIRED AS INDICATED**

(Form OSH-FD-123)

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### FINAL VERIFIED COMPLIANCE REPORT AT COMPLETION

|              | X | X | X | X | | X |

*NOTE: Construction observation may be scheduled at project milestones, at specific intervals, or a combination of both.*

**ABBREVIATIONS:** Geotechnical Engineer of Record (GEOR), Architect of Record (AOR), Structural Engineer of Record (SEOR), Mechanical Engineer of Record (MEOR), Electrical Engineer of Record (EEOR), Contractor or Owner/Builder (CONT), Special Inspector (SP. INSPIR), and Inspector of Record (IOR).
Testing, Inspection and Observation Program
2013 California Building Standards Code – OSHPD 1

E  Samples of Test and Inspection Reports are:  (NOT required for tests performed by laboratories approved through OPL Program)

- Attached
- To be provided following determination of the responsible firm(s) or individual(s). Samples shall be submitted to and approved by the Office, prior to proceeding with the work that requires tests or special inspections.
- Not applicable. Project has no required tests or special inspections.

Required test and inspection reports shall be prepared and submitted to OSHPD/FDD within ___ days of the completion of all tests and inspections. If not designated, all reports shall be submitted to the Office within 15 calendar days.

In addition to the preprinted tests and special inspections identified on this form, this program includes additional tests and special inspections as indicated:

- Other Tests
- Other Special Inspections
- See Attachment

Verification that approved test and inspection agencies are objective, competent and independent as required by the CBC 2013 Section 1703A.1.1:

- Verification of independence and acceptance of test and inspection agencies by Registered Design Professional (RDP) in responsible charge in accordance with the CAC Section 7-141.
- Testing agency qualification for approval or approval of testing agencies through OPL program.
- Inspection agency qualification for approval.

This program has been prepared and submitted for an OSHPD 1 project. OSHPD 1 projects include all construction and remodel projects for general acute care hospitals and acute psychiatric hospitals. OSHPD 1 projects also include construction and remodel of skilled nursing facilities and/or intermediate care facilities except those of single-story, Type V, wood or light steel-frame construction.

Submitted by:

Steven Sugioka  C10245  4/11/2016

Architect/Engineer of Record (Print Name)  Professional License #  Architect/Engineer of Record (Signature)  Date

<table>
<thead>
<tr>
<th>OSHPD Plan Approval</th>
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Testing, Inspection and Observation Program
2013 California Building Standards Code – OSHPD 1

Comments:

NOTE: For Testing, Inspection and Observation Program Instructions, visit our [website](http://www.oshpd.ca.gov).
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Temporary Power and Lighting.
B. Temporary Heating, Cooling & Ventilation.
C. Temporary Water.
D. Temporary Fire Protection.
E. Temporary Telephone.

1.2 RELATED SECTIONS
A. Section 01 11 00 – SUMMARY OF THE WORK
B. Section 01 35 00 – SPECIAL PROCEDURES: General requirements for temporary facilities and controls, to accommodate UCDMC occupancy and use of the areas and spaces adjacent to construction.
C. Section 01 56 10 – AIRBORNE CONTAMINANTS CONTROL
D. Section 01 74 00 – CLEANING
E. Section 01 77 00 – CLOSEOUT PROCEDURES

1.3 TEMPORARY UTILITIES
A. Temporary Connections: Temporary power, water, sewer, gas and other utility services necessary for the Work may be made to existing building systems. Connections shall be subject to University’s review and written approval. Coordinate with utility companies and University’s Plant Operations & Maintenance Department for locations and methods of connections.
B. Contractor shall provide and pay for installation, operation, maintenance, and removal of all utilities.

1.4 TEMPORARY POWER AND LIGHTING
A. Service Requirements:

1. Temporary Electrical Service: Contractor shall provide and pay for installation, operation, maintenance, and removal of temporary electrical service, lighting devices and restoration of existing and permanent equipment in accordance with applicable provisions of the Electrical Safety Orders of the State of California. Use of University’s electrical power and lighting system is prohibited without University’s written approval and will be considered only when an alternate electrical power source is unavailable.
a. Install initial services at time of site mobilization.

b. Modify and extend systems as Work requires.

c. Maintain electrical system to provide continuous service, including prompt restoration of interruptions to University systems when temporary service is connected.

d. Restore existing and permanent lighting used during construction to original condition. Replace defective fixtures, bulbs, and other component parts.

e. Clean existing and permanent lighting fixtures used during construction per Section 01 74 00 – CLEANING.

2. Distribution: Contractor shall provide distribution network for temporary electrical power.

3. Power Source: Arrange for service with University's Plant Operations and Maintenance Department, or local utility company.

4. Conformance: All temporary wiring and electrical facilities shall be in accordance with applicable provisions of Electrical Safety Orders of the State of California.

5. Temporary Lighting: Construction lighting shall be supplied and maintained by Contractor at Contractor's expense. Sufficient lighting levels shall be provided to allow construction to be properly and safely performed. Contractor shall give special attention to adequate lighting for stairs, ladders, floor openings, basements and similar spaces. Promptly replace burnt out, worn or defective parts.

6. Lighting fixtures: Locate fixtures in areas of Work: One (1) lamped fixture in rooms, except closets and utility chases; one (1) lamped fixture for every 750 square feet in large areas.

7. Security Lighting: Contractor shall provide security lighting during hours of low visibility.

B. Distribution requirements:

1. Weatherproof distribution boxes with one (1) - 240 volt, three (3) phase power outlet and four (4) - 120 volt outlets consisting of 100 amperes fused switches with equipment ground, spaced so a 100-foot extension cord will reach all areas of building.

2. Wiring, connections and protection for temporary lighting.

3. Wiring connections and protection for temporary and permanent equipment, for environmental control, for temporary use of electricity operated equipment, and for testing. Power cords shall be GFCI protected when using Hospital outlets.

C. Use of University System: If alternate electrical power and lighting sources are unavailable, University may permit Contractor to use existing, in-place electrical system. University does not guarantee availability of electrical power or adequate lighting levels
through use of existing system. If power and lighting is insufficient or not available Contractor shall provide secondary source (i.e. generator) as approved by University.

1. It is expressly understood and agreed by Contractor that University existing power and lighting system's primary obligation is servicing patient care. The University system is not designed for purposes of construction activities.

2. Contractor should expect power and lighting interruptions during course of Work. Contractor will be required to cease use of University electrical-power and lighting systems, as required by the needs of University.

3. When use of University electrical system is approved in writing, Contractor is required to adhere to University’s electrical lockout procedures. See Division 26 – Electrical.
   a. Provide and maintain warning labels on energized equipment.
   b. Replace plates, electrical devices or similar existing items or components damaged as a result of temporary usage.

1.5 TEMPORARY HEATING, COOLING AND VENTILATING

A. Service Requirements:

1. Contractor shall provide temporary heat as necessary for proper installation of all work and to protect all work and materials against injury from dampness and cold and to dry out building. Fuel, equipment and method shall be approved in writing by University's Representative.

2. Install initial services at time of site mobilization. Modify and extend systems as Work requires.

3. Maintain systems to provide continuous service, including prompt restoration of interruptions to University systems when temporary service is connected.

4. Use of permanent heating system is preferred to any other system for maintaining temperature of building during installation of finish materials, but such use will not be permitted before clean-up after plastering and/or drywall work has been completed. Contractor shall make every effort to complete permanent heating system in time for such use. Permanent fans shall not be used before filters are installed. Filters shall be cleaned and serviced by Contractor just prior to final acceptance.
   a. Vent portable units to building exterior, complete with automatic controls. Direct-fired units are not allowed. Locate units and outlets to provide uniform distribution of heating, cooling and ventilating.
   b. Operate and maintain existing equipment being used; clean or replace filters and install filters in duct extensions as necessary to maintain occupied areas, work areas and finished areas, in specified condition.
   c. Prior to operation of permanent equipment, verify controls and safety devices are complete, equipment has been tested, and inspection made and approved for operation.
d. Remove temporary materials and equipment when permanent system is operational. Restore existing and permanent systems used for temporary purposes to original condition.

e. Install temporary filters in air handling units and ducts, replace as necessary to prevent dust in equipment and ducts, to avoid contaminants in Work or finished areas. After completion, replace temporary filters with new, clean, reusable filters.

5. Maintain temperature, humidity, and ventilation in enclosed areas to provide ambient conditions for storage, preparation and Work; to cure installed materials, to prevent condensation, to dry floor surfaces and to prevent accumulations of dust, fumes and gases.

6. During non-working hours maintain temperature in enclosed areas occupied solely by Contractor at a minimum of 50°F, or higher as specified in individual Sections and by individual product suppliers and manufacturers. Areas occupied in whole or in part by University are to be maintained at normal temperatures.

7. Provide high efficiency particulate air (HEPA) filters as specified in SECTION 01 56 10 – AIRBORNE CONTAMINANTS CONTROL, negative pressure ventilation, or special control of existing system as determined by University’s Representative.

B. Utility Sources:

1. Electrical: As specified above in Item 1.4.

2. Existing mechanical systems may be used for temporary purposes. Coordinate use with University for conditions to be maintained in adjacent University occupied areas.

3. Contractor shall provide and pay for all installation, operation, maintenance and removal of equipment in accordance with applicable provisions of the Electrical Safety Orders of the State of California.

1.6 TEMPORARY WATER

A. Service Requirements:

1. Maintain systems to provide continuous service, including prompt restoration of interruptions to University’s systems when temporary service is connected.

2. Water service, if necessary for construction, can be made available at no expense to the Contractor provided the water is not wasted. Contractor shall be responsible for distribution of water to points of use.

3. Certified reduced pressure type back-flow prevention device as submitted to and approved by University shall be installed before water is obtained from a University campus fire hydrant or interior building connection.

B. Plumbing: Maintain system to provide continuous service with adequate pressure to outlets, including University system when temporary service is connected. See also Division 01 Approvals and ILSM requirements.
1. Size piping to supply construction needs, temporary fire protection, and for University’s needs when existing service is connected.

2. Disinfect piping used for drinking water. See Division 22 for requirements.

3. Source: University existing service, connect at locations as directed by University.

4. Provide valved outlets to control water pressure adequately for hoses.

5. Fire hydrants used for water supply for construction – Contractor must use only ¾” square hydrant wrench on square operating nut and must use only pentagon wrench on pentagon operating nut. This is to prevent damage to the hydrant operating nut. Any damage caused by the use of an improper wrench or other misuse of the hydrant must be repaired at contractor expense. Contractor must inspect hydrant prior to use and make the University aware of any pre-existing damage.

C. Use of Existing System: Existing system may be used for temporary water. Monitor usage to prevent interference with University’s normal operational requirements.

D. Use of Permanent System: Contractor shall obtain written agreement from University establishing start of warranty period and conditions of use.

E. Contractor shall pay for installation, operation and maintenance of system and restoration of existing and permanent equipment. University will pay costs of water consumed for normal construction operations. Contractor shall take measures to conserve usage.

1.7 TEMPORARY FIRE PROTECTION

A. Requirements:

1. Maintain systems to provide continuous service, including prompt restoration of interruptions to University systems when temporary service is connected.

2. Provide and maintain fire protection equipment including extinguishers, fire hoses and other equipment as necessary for proper fire protection during course of the Work.

3. Use fire protection equipment only for fighting fires.

4. Locate fire extinguishers in field offices, storage sheds, tool houses, other temporary buildings and throughout construction site. In area under construction, provide at least one (1) fire extinguisher for each 5,000 square feet of building floor area. Locate fire extinguishers so that a person never has to walk more than seventy-five (75) feet to obtain one.

5. Assign qualified person with authority to maintain fire protection equipment, institute fire prevention measures, and direct prompt removal of combustible and waste material. Submit ILSM requirements per Specification SECTION 01 35 00 – SPECIAL PROCEDURES.

1.8 TEMPORARY TELEPHONE
A. Service Requirements:

1. Maintain systems to provide continuous service, including prompt restoration of interruptions to University systems when temporary service is connected.

2. Contractor shall select from the following options:

   a. University shall provide conduit, cabling and dial tone to Contractor's location(s). Contractor shall pay University for cable, conduit installation and later removal of same and also pay University a monthly fee for use of University telephone system.

   b. University shall provide conduit and cabling to Contractor's location(s). Contractor shall receive dial tone from local utility. Contractor shall pay University for cabling, conduit installation, maintenance of same and later removal of same. Contractor shall pay local utility for monthly telephone service.

3. Contractor shall select number of lines, instruments and other features.

4. Contractor shall prepare and submit to University, "UNIVERSITY TELECOMMUNICATION TELEPHONE SERVICE FOR OUTSIDE CONTRACTORS" form. Refer to attached form at end of this section.

B. Use of Existing System: Existing University telephone system shall not be used for temporary telephone service.

C. Contractor Phone:

1. Contractor shall have telephone emergency number or other facility available at Contractor's business office for duration of contract where contractor and superintendent may be contacted within twenty-four (24) hours. Provide emergency numbers to University.

D. Telephones:

1. Contractor shall use, and only permit to be used, FCC approved communication devices on frequencies approved by FCC and University.

2. Contractor shall not use, or permit to be used, communication devices which interfere with existing University communication systems, including, but not limited to:

   a. Life Flight or CHP helicopters.
   b. Emergency Service vehicle communications.
   d. Microwave transmission stations.
   e. UCDMC closed-circuit television or radio signals.
   f. Cellular or other mobile phone systems in main hospital.
g. UCDMC voice or digital paging systems.

PART 2 - PRODUCTS

2.1 MATERIALS

A. May be new or used, adequate to the purpose.

B. Devices and Equipment: Standard devices, meeting UL requirements.

C. Telephones: may be product of local service company or specialty devices compatible with service company requirements.

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 50 00
UC Davis Health System
Telephone Service for Construction Trailers/Work Sites

**UCDMC Project Managers**

When construction bids are awarded, please include this form in the project packet. Contact Jim Fralick at 916-734-3399 or Amy Yee at 916-734-8000 in Telecommunications to verify the correct termination point for each project.

**CONTRACTORS**

To order telephone service for your construction site at UC Davis Medical Center, please use the following instructions – see page 2 for additional information:

- Call AT&T at “800-750-2355” to order your telephone lines. You will need to give them the following information:
  
  - Bring service to: 2315 Stockton Blvd, Sacramento, CA – 1.1 MPOE, Admin Bldg (or other location as designated)
  - a. Site contact person = Amy Yee, 916-734-8000
  - b. Request the installer to call Amy Yee with binding post information

- AT&T will provide the new assigned telephone numbers, an order number and the installation date.
- Enter the information onto the form below.
- Fax the completed form to: UC Davis Medical Center, Telecommunications
  - Fax # 916-456-8331
  - Attention: Amy Yee – 916-734-8000
  - amy.yee@ucdmc.ucdavis.edu

Date: ______________  Project Name: ______________________________________________________

Company Name: _____________________________________________________________________

Contact Name: _____________________________________________________________________

Phone or Cellular #: ___________________  Email address: _______________________________

Location of construction site:

UCDHS Project Manager: ______________  Phone #: ________________________________

**AT&T Order Information**

Telephone number assignments: _________________________________________________________

AT&T Order #: _______________________  Pacific Bell due date: _________________________

**Note:** This form is to be used for ALL telephone services ordered for this project, including Fax Lines, Modem/DSL Lines and Payphones.
The following are typical telephone system safety practices required by the subs to get site-accessed phone, T1, DSL and fax services:

1. Cabling from the University splice point to the trailer needs to be "pic" (gel filled) outside plant cable (Superior Essex-Sealpic-24 ga, 6, 12 pair, Graybar cut to length) protection against the elements and accidental faults. Requires 8-foot minimum pigtail at the splice box.

2. DMARC at trailer needs to have a primary protection module (Sec 800-30&41 CEC-2002, found at Graybar) with 2, 4, 6, 8, pair protection to receive the cable from the splice.

3. 1-8 foot copper coated ground rod placed at the trailer and wired by an electrician to the trailer power ground (building) and Telephone primary protector module.

UC Davis Medical Center contact for additional information: Jim Fralick – 916-734-3399
SECTION 01 52 00
CONSTRUCTION FACILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Field Offices and Sheds
B. Temporary Facilities
C. Temporary Sanitary Facilities

1.2 RELATED SECTIONS

A. Section 01 11 00 – SUMMARY OF THE WORK
B. Section 01 35 00 – SPECIAL PROCEDURES: General requirements for temporary facilities and temporary controls to accommodate University continued occupancy and use of the areas and spaces adjacent to construction.
C. Section 01 74 00 – CLEANING
D. Section 01 77 00 – CLOSEOUT PROCEDURES

1.3 FIELD OFFICES AND SHEDS

A. Field Office: Contractor shall provide a job office that will conform to the following minimum requirements:
   1. Suitable space for drawings, specifications, samples and other project records.
   2. Conference space for eight (8) persons, including layout tables.
   3. Heating and cooling to maintain a reasonable working environment.
   4. Telephone service as specified in Section 01 51 00 – TEMPORARY UTILITIES
   5. Furnishings required: Conference table and chairs; racks and files for Contract Documents, submittals, and project record documents. Other furnishings are at Contractor’s option.

B. Installation: Install office spaces for occupancy fifteen (15) calendar days after date of University/Contractor agreement.

C. Preparation: Fill and grade sites for temporary structures to provide drainage away from buildings.

D. Contract Documents: Complete set of Contract Drawings and Contract Specifications shall be kept continuously at the site. Copies of all Change Orders, letters, Shop Drawings, etc., shall be kept on the job-site at all times and shall be available for inspector’s use.
E. Contact numbers: Contractor shall provide telephone numbers where Contractor may be reached at all times during normal working hours and also after normal working hours, if emergency problems develop that require Contractor's assistance.

F. Storage Sheds and Containers for Materials, Tools and Equipment: If requested, University will provide space outside construction site where Contractor may provide and locate weather-tight sheds or containers for storage of construction materials, tools and equipment. Contractor shall be solely responsible for security of such sheds and containers. Size storage requirements to allow access, orderly provision of maintenance and inspection of products.

G. Cleaning: Weekly janitorial services for offices; periodic cleaning and maintenance for office and storage areas. Contractor shall keep construction loading and parking areas clear of construction debris, especially debris that may cause slipping or tripping hazard that may injure vehicle tires, that may stain surfaces, and that may be tracked into existing buildings. Maintain approach walks free of mud and water.

H. Removal: Upon completion of the work, and before the final payment, Contractor shall remove all temporary work and facilities and return site to condition required by the General Conditions of the Contract and at no change to the Contract Sum or the Contract Time.

1.4 TEMPORARY FACILITIES

A. Contractor shall provide and maintain the following temporary facilities as required for execution of the Work:

1. Scaffolding, staging, runways and similar equipment.

2. Hoists or construction elevators, complete with operators, power and signals required.

3. Temporary rigging, rubbish chutes, barricades around openings, ladders between floors, and similar equipment.

4. Barricades, fencing, lights and similar safety precautions.

B. Maintenance: Use all means necessary to maintain temporary construction facilities and controls in proper and safe condition throughout progress of the Work.

C. Replacement: In event of loss or damage, promptly restore temporary construction facilities and controls by repair or replacement at no change to the Contract Sum or the Contract Time.

D. Conformance: All materials and equipment required to safely accomplish work under this Section shall be in conformance with requirements of CAL OSHA and other State and Federal Codes and regulations where applicable.

E. Codes: All temporary work and facilities shall conform to the above requirements that pertain to operation, safety and fire hazard.

F. Construction Site Security: Temporary barriers, doors and gates shall be keyed to University’s master lock system. Security hardware to be provided by Contractor. Keying to University master lock system will be provided by University.
1.5 TEMPORARY SANITARY FACILITIES

A. Use of existing facilities: Designated toilet facilities may be used by Contractor.
   1. Assigned facilities: Location of assigned toilet facilities and maintenance of same are responsibility of University. Contractor shall not have exclusive use to these facilities and shall abide by health and safety criteria regarding their use and sanitary upkeep.
   2. Unassigned facilities: Unassigned toilet facilities shall not be used without written authorization of University's Representative.
   3. Contractor may use existing toilet facilities that are within the limits of the Work.

B. Contractor shall pay service charges for connection and use of sewage utilities.

C. Portable units: Enclosed, portable, self-contained units or temporary water closets and urinals, secluded from public view may be used. Self-contained units shall be approved by University's Representative prior to use.
   2. Provide facilities at time of site mobilization.
   3. Modify and extend services as work progress requires.
   4. When utility services are available, provide water, sewer service, and temporary water closets; remove portable facilities. Remove temporary fixtures when permanent facilities are operational.
   5. Clean areas of facilities daily, maintain in sanitary condition. Disinfect fixtures, repair or replace damaged fixtures, accessories and surfaces.
   6. Provide toilet paper, paper towels, and soap in suitable dispensers.
   7. Restore existing and permanent areas and facilities used to original condition.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Serviceable, new or used, adequate for required purpose.

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 52 00
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Construction Parking and Access Roads
B. Traffic Regulation
C. Project Informational Signs

1.2 RELATED SECTIONS

A. Section 01 11 00 – SUMMARY OF THE WORK
B. Section 01 33 23 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
C. Section 01 35 00 – SPECIAL PROCEDURES: General requirements for temporary facilities and temporary controls to accommodate University's continued occupancy and use of the areas and spaces adjacent to construction.
D. Section 01 74 00 – CLEANING
E. Section 01 77 00 – CLOSEOUT PROCEDURES: Project Closeout.

1.3 PARKING AREAS AND ACCESS ROADS

A. Access Roads: Existing roads shall be used for construction access within limits defined herein. Temporary construction access roads shall not be permitted.

B. Parking: Parking is controlled and limited by University.

1. Parking of personal vehicles belonging to Contractor employees may be arranged with University's Parking Services, at 916-734-2687. Parking will be allowed in employee permit areas, at the current permit rates depending on space availability. All permits must be purchased on cash basis.

2. Delivery of materials may be made to the job-site as required. Contractor shall coordinate with University's Representative.

3. Dumpsters shall be located in approved location as arranged by University's Representative.

C. Existing Pavements and Parking Areas: Designated existing on-site streets and driveways may be used for construction traffic. Vehicles with metal tracks will not be allowed.

1. Designated areas of existing parking facilities may be used by construction personnel. Do not allow heavy vehicles or construction equipment in parking areas.
2. Maintain traffic and parking areas in a sound condition, free of excavating material, construction equipment, products, mud, snow and ice.

3. Maintain existing and permanent paved areas used for construction. Repair existing facilities damaged by usage to original condition: promptly repair breaks, potholes, low areas, standing water and other deficiencies, to maintain paving and drainage in original or specified condition.

4. Remove temporary materials and construction when permanent paving is usable.

1.4 TRAFFIC REGULATION

A. Schedule of Access Closing: Contractor shall adopt all practical means to minimize interference to traffic. Access to other facilities in the area shall be maintained at all times. Contractor shall provide schedule of planned closing of any street for approval by University and shall give minimum of fourteen (14) calendar days notice before closing any street or access.

B. Use of Fire Lanes: Contractor shall notify University of all major pickups and deliveries that require use of controlled access fire lanes. Keys to gates or other barriers will be provided, as needed, to allow use of fire lanes. Vehicles parked in fire lanes for delivery of materials shall be continuously manned for immediate removal if required by the University.

C. All major pick-up and delivery operations shall occur in total before or after normal working hours.

1. Drawings may indicate haul routes designated by University for use of construction traffic. Confine construction traffic to haul routes.

2. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

D. Post-mounted and wall-mounted traffic control and informational signs as specified herein.

1. Traffic Control Signs, Cones, Drums, Flares, Lights and Flag Control equipment: All as approved by local jurisdiction.

2. Contractor shall furnish at all barricades: Lights and flag control required to control traffic, and shall also provide and maintain suitable temporary barricades, fences, directional signs, or other structures as required for protection of the public; and maintain from the beginning of twilight throughout the whole of every night on or near the obstructions, sufficient lights and barricades to protect the public and/or the Work.

E. Construction Vehicle Parking: Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and University’s operations. Prevent parking on or adjacent to roads or in non-designated areas.

F. Flag Control: Provide properly trained and equipped flagmen to regulate vehicular traffic when construction operations or traffic encroach on public traffic ways.

1. Provide properly trained and equipped personnel to regulate pedestrian traffic at all interior locations where construction traffic interfaces with University traffic.
2. Flag control personnel shall wear appropriate identifying clothing such as bright colored vests, clearly visible and identifiable as having responsibility for traffic control.

G. Lights: Use lights during hours of low visibility to delineate traffic lanes and to guide traffic.

H. Traffic Signs and Signals: At approaches to site and on site, install traffic signs and signals at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.

1. Install and operate traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control, and areas affected by Contractor's operations.

2. Relocate traffic signs and signals as Work progresses, to maintain effective traffic control.

3. Remove equipment and devices when no longer required. Repair damage caused by installation.

1.5 PROJECT INFORMATIONAL SIGNS

A. Project Identification Sign: Contractor shall provide one (1) project sign. Sign will consist of one (1) 8' x 4' x ¾” exterior grade plywood with medium or high density phenolic sheet overlay, painted plywood sign on fence area at construction field office or yard.

1. Information on sign shall include PROJECT NAME, University of California, Davis Medical Center, University's consultants, etc. Copy will be provided by the University.

B. Painted Informational Signs: Provide at each field office, storage shed and yard, directional signs to direct traffic into and within site. Relocate as Work progress requires.

C. Maintain signs and supports: Clean, repair deterioration and damages.

D. Remove signs, framing, supports and foundations at completion of Project and restore the area.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 55 00
PART I - GENERAL

1.01 SECTION INCLUDES

A. Barriers and Enclosures
B. Protected Walkways and Weather Closures
C. Tree and Plant Protection
D. Temporary Controls

1.02 RELATED SECTIONS

A. Section 01 11 00 – SUMMARY OF THE WORK
B. Section 01 35 00 – SPECIAL PROCEDURES
C. Section 01 56 10 – AIRBORNE CONTAMINANTS CONTROL
D. Section 01 74 00 – CLEANING

1.03 BARRIERS AND ENCLOSURES

A. Barricades: Provide to prevent public entry, to protect existing trees and plants, and to protect existing facilities and adjacent properties from damage during construction period. Relocate and extend as construction progress requires.

B. Partitions and Ceiling Enclosures:

1. Fire Enclosures-Rated-Corridors and Rated Assemblies: Provide non-combustible dust-proof barrier framed with metal studs spaced 24" o/c maximum and covered on both sides with ⅝" thick Type-X rated gypsum wallboard taped, braced so to be self-supporting without fastening to existing finishes.

   a. Provide gaskets of closed cell neoprene, or strips of fiberglass insulation between barriers and existing finish.

   b. Finish exposed surfaces with two (2) coats of paint (color as selected by University), maintain in neat, orderly appearance and paint barrier on public side. Temporary emergency exit and or directional signage indicating Emergency Exits will be furnished and installed by Contractor.

   c. Provide temporary doors in corridors with twenty (20) minute fire-rated assemblies and locksets to limit use.

   d. Use of access doors and routes by workmen to be approved by University's Representative.
2. Fire Retardant Enclosures - Non-Rated Assemblies: Provide non-combustible dust-proof barriers framed with metal studs and covered on public side with Fire Retardant plastic laminate sheathing material. Flame spread 10 - smoke development 45 - fuel contribution undeterminable, as manufactured by Reef Industries, Inc., P.O. Box 33248, Houston, TX 77033 or equal.
   a. Joints shall be taped and sealed over framing studs.
   b. Bracing shall be self-supporting without fastening to existing finishes.
   c. Provide gaskets of closed cell neoprene, or strips of fiberglass insulation between barriers and existing finishes.
   d. Provide non-staining taped seal to surrounding materials to insure seal.
   e. Non-Rated Assemblies for Dust Control: Use ½” Type-X or equal gypsum wallboard applied on occupancy side on framing member. Joints over studs shall be taped and sealed. Other detail similar to 1.03-B.2 above.

C. Removal: Remove temporary materials, equipment and construction at completion; repair damage caused by installation or use of barricades and enclosures. Restore existing facilities used during construction to specified, or to original condition.

1.04 DIESEL VEHICLE/EQUIPMENT IDLING PROCEDURES

A. When drivers of diesel powered on-road vehicles arrive at loading or unloading areas to drop-off or pick-up passengers, supplies, equipment, materials, etc., they shall turn off their vehicle’s engine as soon as possible but no later than five minutes after arrival.

B. Operators of off-road diesel powered equipment shall turn off their engines when the equipment is not performing its primary function, but no later than five minutes after the equipment has come to a stop.

C. Idling for “warm-up” prior to diesel vehicle or equipment operations on UCDMC property shall be limited to a maximum of five minutes.

D. At end of work shift, or for the purpose of servicing, all diesel equipment shall be parked on site at furthest location away from Hospital air intake systems.

E. All diesel powered equipment shall be maintained in good operating condition. University representative will direct Contractor to remove any equipment producing high amount of diesel fumes resulting from diesel equipment being old or in poor operating condition.

1.05 PROTECTED WALKWAYS AND WEATHER CLOSURES

A. Cover walkways to provide access to existing facilities for use by public and University personnel.

B. Provide temporary roofing and weather-tight insulated closures of openings in exterior wall surfaces, to maintain specified working conditions, to protect products and finished work from inclement weather.
1.06 TREE AND PLANT PROTECTION

A. Tree Protection: All trees not marked for removal shall be protected against damage from construction operations. Where necessary, in the opinion of University's Representative, trees surrounding building footprint or in close proximity to construction operation shall be protected with barricades. No trees shall be cut or felled without approval of University's Representative. Trees cut and/or removed without explicit instruction shall be replaced by Contractor at no cost to University.

B. Cutting and Pruning: Cutting and pruning of trees to accommodate construction shall be done only with approval and direction by University's Representative. Soil within the spread of tree branches (within drip line) shall not be disturbed except as directed by excavation or trenching drawings. Advance notice shall be given University if tree roots of 3" diameter or greater must be cut.

C. Drip line Protection: Cars, trucks, or equipment shall NOT be parked or set within the drip line of any tree; nor shall there be any stockpiling or temporary building erected within the drip line.

1.07 TEMPORARY CONTROLS

A. Dust Control: Contractor shall take appropriate steps throughout project to prohibit airborne dust due to work under this contract. Execute work by methods to minimize raising dust from construction operations. Water shall be applied wherever practical to settle and hold dust to minimum, particularly during demolition and moving of materials. No chemical dust prohibitor shall be used without written approval by University's Representative.

B. Water Control: Contractor shall pre-coordinate staging areas and provide appropriate materials to cleanup and control water due to accidental pipe leaks and/or construction that requires the use of water (e.g. concrete coring).

C. Noise Control: Control noise as directed by University's Representative.

D. Pollution Control: Use of noxious or toxic materials for all applications in alterations or work in buildings occupied by University personnel shall be done after proper notification and approval by University, this includes work performed on weekends or other unoccupied times.

1. Provide methods, means and facilities to prevent contamination of soil, water and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations.

E. Waste Control: All waste materials resulting from process of clearing and construction shall be disposed of as follows:

1. General Refuse: All refuse and debris, combustible and incombustible, resulting from construction process, shall be removed from University property as described in the General Conditions of the Contract. Contractor shall not use any refuse container belonging to University.

2. Hazardous Refuse: Solvents, oils and any other hazardous material shall be disposed of in containers and removed from site. At completion of work, any contaminated soil shall be removed and replaced with good soil by Contractor at no expense to University. Coordinate disposal with UCDMC EH&S department.
3. Building materials containing asbestos that are part of the project shall not be disturbed or removed by the contractor during the construction of temporary barriers, enclosures and controls. The contractor shall request from the University’s Representative materials that have been identified on the project to contain asbestos so that these materials are not disturbed. The contractor shall refer to Section 01350 Special Procedures, 1.05 Hazardous Materials Procedures regarding materials impacted by construction of temporary barriers, enclosures and controls.

4. All material and equipment removed as part of the Project is property of University, unless specifically designated otherwise; such material and equipment shall be delivered to a location at Medical Center, as directed by University, to be selectively sorted by University; remaining debris shall be disposed of by Contractor at no expense to University.

F. Drainage Control: All portions of Work shall be kept free of standing water at all times during construction. Where required, temporary drainage ditches, berms, or pumping systems shall be constructed to divert drainage water from construction site, and resultant water shall be carried to nearest natural water course and disposed of without erosion to surrounding area. Care shall be taken to prevent silting of existing sinkholes and water-courses. Silt deposited as a result of the Work shall be removed and disposed of by Contractor at no cost to University.

1. Rough grade site to prevent standing water and to direct surface drainage away from excavations, trenches, adjoining properties and public right-of-ways.

2. Maintain excavations and trenches free of water. Provide and operate pumping equipment of a capacity to control water flow.

3. Provide de-watering system and pumping to maintain excavations dry and free of water inflow on a twenty-four (24) hour basis.

4. Provide piping to handle pumping outflow to discharge in manner to avoid erosion or deposit of silt. Provide settling basins to avoid silting; install erosion control at out-falls of system.

5. Remove equipment and installation when no longer needed.

G. Sediment and Erosion Control: Contractor shall furnish, install and maintain means and methods to reduce excessive erosion, minimize sedimentation discharge, and prevent construction materials discharge from causing off-site and on-site contamination. Contractor shall coordinate with University.

1. Contractor shall pay for and maintain required permits.

2. Contractor shall furnish:
   a. National Pollutant Discharge Elimination (NPDE) permit.
   b. Contractor shall file Notice of Intent to California State Water Resources Control Board (SWRCB) stating date construction will begin. Provide copy to University.
   c. Contractor shall prepare, maintain and follow Storm Water prevention Plan. The Plan shall include Contractor’s Best Management Practices.
(BMP) describing means and methods to control sediment, erosion and other pollutants.

d. Contractor shall keep BMP Program at job-site.

PART II - PRODUCTS

2.01 Construction Barriers: Polyethylene used for critical barriers and for sealing walls, floors or ceiling systems shall be a minimum of 6 mil thickness and fire retardant type listed by Fire Underwriters Laboratories, Griffolyn #T55R with Griffolyn fire retardant tape, or equal, (no known equal).

2.02 Water Control: Plastic tanks, appropriate diameters of corrugated ADS piping, floor squeegees, mops, mop buckets, towels, etc. as required to control water.

PART III - EXECUTION

3.01 Infection Control Risk Assessment ICRA Requirements:

1. Refer to attached Airborne Contaminants Controls, Infection Control Risk Assessment (ICRA) Appendix A, Appendix B, and Appendix C.

   a. These documents dictate minimum requirements for Class I and II containments and minimum requirements that must be completed to control dust during construction.

   1) Mini-containments (pop-up cubes) which are designed to have at most 1-2 people may be used in lieu of custom built Class II Containments.

2. The outside of the containment shall have posted: 01561 ICRA Permit, 01350 Interim Life Safety Measure (ILSM) Permit, Daily ICRA Inspection Forms, entry warning sign, Containment Entry Log (provided by the contractor) that lists all persons who enter the containment regardless of affiliation, including all UC employees, an emergency telephone number of person to call 24 hours.

3. Before any demolition or construction begins, all Protection Areas (infection control areas), control measures put in place and work plan by the Contractor will be inspected by a designated representative of UCDMC. Work cannot begin until the work containment has been inspected and approved.

END OF SECTION 01 56 00
SECTION 01 56 10
AIRBORNE CONTAMINANTS CONTROL

PART I - GENERAL

1.01 SUMMARY

A. Section Includes: university airborne contaminants control policy procedures and an Infection Control Risk Assessment (ICRA) and plan.

1.02 POLICY

A. Airborne contaminants control is critical in all hospital areas. Contractor shall limit dissemination of airborne contaminants produced by construction-related activities, including dust, chalk, powders, aerosols, fumes, fibers and other similar materials, in order to provide protection of immuno-compromised and other patients, staff, diagnostic operations, or sensitive procedures or equipment, from possible undesirable effects of exposure to such contaminants.

1. Construction activities causing disturbance of existing dust, or creating new dust, or other airborne contaminants, must be conducted in tight enclosures cutting off any flow of particles into patient areas.

2. Ceilings, walls in Protection Areas and other areas in patient care areas as indicated on drawings must be secure at all times.

B. An Infection Control Risk Assessment (ICRA) and plan to mitigate dust is required for each project. The risk assessment identifies patient groups at risk for infection due to construction dust. The dust mitigation plan is designed to contain dust within the construction zone. Some hospitalized patients are fragile. These patients are at risk for acquiring infections from bacteria and viruses that are transported on air currents from the construction zone to the patient areas. Dust is a method for germs to move through the hospital. The ICRA and dust mitigation plan assures a clean, safe environment for the patients hospitalized during construction. Hospital management is expecting your assistance in providing the best possible environment for the patients. We appreciate your partnership in the campaign to prevent a hospital acquired infection related to construction dust.

C. If visible mold is found during construction, renovation, or repairs, any ICRA in-hand is invalid and risk assessment shall be performed to reevaluate ICRA levels and the work plan prior to restart of the work. Upon discovering, seal any openings, stop work and notify the UCDHS Representative immediately. This includes projects that are already considered and operating under a Class IV.

D. Related Sections:

1. Section 01 73 29 – CUTTING AND PATCHING: Removal of debris may be outside of normal work hours and shall be in tightly covered containers.

2. Section 01 35 00 – SPECIAL PROCEDURES: Perform work in accordance with requirements of this section.
3. **Section 01 50 00 – TEMPORARY UTILITIES:** Provide high efficiency particulate air (HEPA) filters as specified in Section 01561, negative pressure ventilation, or special control of existing system as determined by University's Representative.

4. **Section 01 56 00 – TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS:** Extend barriers above ceilings as required to seal off and contain airborne contaminants.

5. **Section 01 56 00 – TEMPORARY CONTROLS:** Contain waste materials during removal; bagging, wrapping, and transporting.

6. **Section 01 74 00 – CLEANING:** Use wet cleaning methods and HEPA filtered vacuum cleaners as required to minimize release of airborne contaminants. Contain waste materials, debris and rubbish as noted above. Disinfect Containment and Protection Areas as directed by University's Representative.

E. **Dust Mitigation Requirements**

1. An ICRA Daily Compliance Survey is attached at the end of this section. The Contractor must complete this daily checklist and leave posted for the duration of the project at the outside of the containment. Any areas of non-compliance must be specifically listed and addressed for corrective measures when identified. A copy of the daily ICRA inspections shall be submitted to the University's Representative at an agreed upon time between the contractor and the Project Manager.

**1.03 SUBMITTALS**

A. Submit to Project Inspector or Post at Anteroom Daily ICRA Compliance Survey.

B. Schedules: Submit work areas and procedure schedules for containment of airborne contaminants.

C. Work Plan: Drawings and details of construction of necessary temporary barriers, and description of procedures to be used to achieve and maintain control of construction-related airborne contaminants. As applicable, the drawing should include the following: location of ante room(s), location of manometer, location of negative air units exhausting outside the building including number of negative air units and sizes (cfm), and location of sealed blocked off areas of corridors. Any impacts to corridors will need to be approved via ILSM (see specification section 01350 for details).

D. Project Experience and Training: In order to be considered qualified to work with negative pressure containments; contractors must demonstrate experience by providing either of the following:

1. Previously completed, documented negative pressure containment work in a healthcare facility along with an owner reference. Minimum documentation shall include project descriptions and photographs or containment schematics.

2. Documentation that the contractors’ proposed foreman has successfully obtained one of the following from the American Society for Healthcare Engineering (ASHE):

   a. Certified Healthcare Constructor (CHC) Certification
b. Health Care Construction (HCC) Certificate

c. Managing Infection Prevention during the Construction & Operation of Health Care Facilities Course Completion
1.04 QUALITY CONTROL

A. Pre-construction Meeting: Before any construction on site begins, Contractor's Superintendent is required to attend a mandatory pre-construction orientation session held by University's Representative for a review on precautions to be taken.

B. Review by PO&M HVAC staff for possibility to disconnect air supply and return into the project area. Negative air machines shall be connected to separate electrical circuits.

C. Notification: A minimum of fourteen (14) calendar days written notification to University's Representative of possible construction activity causing airborne contaminants in Protection Areas.

1.05 DEFINITIONS

A. Containment Areas: As determined by University's Representative and if shown. Includes all areas of construction activities, adjacent staging and storage areas, and passage areas for workers, supplies and waste. The containment area includes ceiling spaces above and adjacent to construction activities.

B. Critical Openings – Include all potential paths for air and contaminants to move from the project area to outside of the project area and include: supply registers, return registers, exhaust registers, doors, windows, and other openings within the area where contaminants can escape. Sealing the critical openings can be accomplished with tape, plastic, hard barriers and a combination of these materials to seal airtight the critical opening.

C. HEPA System DOP Testing – An ANSI / ASTM recognized method to test the integrity of a High Efficiency Particulate filter which filters out 99.97% of particles 0.3 micrometers or larger. DOP testing is performed by specialty contractors. The Health System requires that HEPA systems be tested to the ANSI / ASTM standard as delivered prior to their use onsite as further described in this Standard.

D. ICRA (ICRA) Infection Control Risk Assessment - An evaluation of patient risk based on a matrix of the patient population health in the work area and the invasiveness of the project. This assessment ultimately generates a permit issued by Infection Prevention requiring compliance with one of four precaution levels. The ICRA program is documented in Hospital P&P 2120. ICRAs apply to patient care areas and their adjoining contiguous areas. All ICRA evaluations are the sole responsibility of the Health System Infection Prevention Department based on an application by the Project Manager.

1.06 PERFORMANCE REQUIREMENTS

A. University's Representative's Responsibilities:

1. Determination of the Containment and Protection Areas, as well as, the standard of limitations of the Contractor's responsibilities, required for the project.

2. Statement of Requirements: Description in graphic and written form as required to communicate the above based on evaluation of the construction area and the impact of the project on patient care.
3. Coordinate any testing and monitoring as necessary with EH&S or a third party.

B. Contractor Responsibilities:

1. Provide specific means and methods of achieving and maintaining control of airborne contaminants during construction.

2. Implement all mitigation measures as listed in the UCDMC Construction Dust & Hazardous Materials Inspection Worksheet, which have been reviewed and approved by Infection Prevention and EH&S. The work shall be performed in accordance with the specific ICRA/Dust Mitigation Plan, Class (I, II, III or IV), depending upon the location of work. In general, all demolition of interior building materials will be within negative pressure enclosures (Class III) or class IV where asbestos materials will be removed.

3. Contractor shall ensure that all workers are trained and adhere to the mitigation requirements.

4. Contractor shall notify University’s Representative in writing, a minimum of fourteen (14) calendar days prior to starting construction activity, which might be expected to produce excess levels of airborne contaminants in containment area so that additional precautions may be taken.

PART II - PRODUCTS

2.01 MATERIALS

A. Polyethylene: Polyethylene used for critical barriers and for sealing walls, floors or ceiling systems shall be a minimum of 6 mil thickness and fire retardant type listed by Fire Underwriters Laboratories, Griffolyn #T55R with Griffolyn fire retardant tape, or equal, (no known equal).

PART III - EXECUTION

3.01 PROJECT SPECIFIC REQUIREMENTS: The below criteria shall be applied on a case by case basis as outlined in the project specific requirements, ICRA Permit(s), and EH&S Worksheet(s)

A. Refer to the ICRA Permit(s) and EH&S Work Sheet(s) prepared for the project.

B. All Containment Areas: All asbestos related work will be in Class IV negative pressure containments. Non-asbestos material demolition will be in Class III negative pressure containments but may be upgraded to Class IV when access to the project site is adjacent to actively occupied spaces.

C. Final cleaning of Containment: Only the areas of asbestos abatement will have a clearance criteria that include both a visual inspection and clearance by air sampling with analysis for asbestos by transmission electron microscopy (TEM).

D. Particle Counting: particle counting might be conducted in containments that are immediately adjacent to occupied areas of the hospital.

3.02 CONTAINMENT CRITERIA

A. The outside of the work containment shall have present: ICRA Permit, Interim Life Safety Measure (ILSM) Permit, Daily ICRA Inspection Forms, manometer, entry warning sign,
Containment Entry Log (provided by the contractor) that lists all persons who enter the containment regardless of affiliation, including all UC employees, an emergency telephone number of person to call 24 hours a day in the event of a negative pressure alarm or other issue, and that an Environment of Care Incident Report under the category of “Construction Dust” must be filed by area nursing management in case of constant or annoying alarms.

B. The interior of the containment area shall be cleaned on a continual basis daily. Hard surface floors in work area, adjacent hallways and passage areas require vacuuming with HEPA-filtered vacuum cleaners and frequent wet-mopping during demolition and construction; protect adjacent carpeted areas with plastic and plywood and vacuum with HEPA-filtered vacuum cleaners. Only an EPA Listed Germicide approved by the UCDMC Infection Prevention shall be used on the project site.

C. Regardless of containment strategies, execute work by methods to minimize raising dust from construction operations. Water may be used to assist in controlling airborne dust.

D. Full containment

1. All surfaces in the containment area except surface where work is to occur must be covered in plastic unless they are non-porous, smooth, and accessible for cleaning.

2. Sealing of Openings: Use tape or other impenetrable sealant to seal barrier wall seams, cracks around window and door frames, exhaust system ductwork, pipes, joints and ducts. Use of spray glue is not acceptable to be used inside of the building.

3. Contractor must block off existing ventilation supply registers, return registers and exhaust registers in the construction area.

4. All polyethylene and other materials used for temporary enclosures shall be at least 6 mil thickness and fire retardant type. Zip poles or other easily removable supports shall be used for projects extending beyond one work shift. Temporary walls with metal stud framing may be required for long term projects and must be approved by the Project Manager. All doors leading into the containment area shall utilize zippered doors for control of the air flow and closing the plastic doors.

E. Critical seal of areas

1. Use tape or other impenetrable sealant to seal barrier wall seams, cracks around window and door frames, exhaust system ductwork, pipes, joints and ducts. Use of spray glue is not acceptable to be used inside of the building.

F. Cubes

1. Mini-containments (pop-up cubes) which are designed to have at most 1-2 people are means of control to access attic spaces, wall spaces and subfloor spaces usually at defined entry points such as access hatches or above a drop-in ceiling system. Cubes are reviewed and approved by the university’s representative on a case by case basis.

G. Glove Boxes
1. A glove box can be used for some work where a HEPA filtered vacuum is attached to the glove box when a small area of work is to be performed. A glove bag is attached to the box enclosure to allow the worker to make small openings by drilling or cutting within the negative pressure glove box. Glove boxes are reviewed and approved by the university's representative on a case by case basis.

H. Shrouded tools

1. Shrouded tools can be used for some work. A HEPA (DOP Tested) filtered vacuum is attached to the shroud. Shrouded tools are reviewed and approved by the university's representative on a case by case basis.

3.03 NEGATIVE AIR CRITERIA

A. Under no circumstances shall the HEPA filtered air be discharged into existing HVAC returns, exhaust ducting or building plenum spaces.

B. When the air from the HEPA filtered negative air unit exhaust cannot be directed outside of the building due to no windows in the vicinity of the work or if impractical, all HEPA filtered negative air units shall be exhausted to a location agreeable to the PM. Each HEPA unit shall be plugged into a separate electrical circuit to provide temporary redundancy should one unit fail or due loss of electrical power. The PO&M Electrical shop shall inspect and test each circuit connected to the HEPA negative air unit prior to use.

C. When the air from the negative air units are exhausted inside of the building, the exhaust air from negative air unit shall be directed into a “diffusion cube” constructed of pleated filters to disperse the air in a manner that does not raise dust or blow air directly onto patients, staff or visitors. The contractor shall consider and install charcoal filters in the negative air units to control smells/odors associated with the construction.

D. Negative air units shall be positioned as far from the entry ante room containment as possible for distribution of air flow throughout the project area. The number of negative air units shall be to provide sufficient negative pressure and for a minimum of at least four (4) air changes per hour of the volume of the entire work containment.

E. Dual HEPA Units operating in parallel may be required for redundancy in high risk areas.

F. DOP testing of HEPA equipment

1. Negative air units and HEPA filtered vacuums are to be challenge tested onsite by the DOP test method by a third party prior to being placed in service, after a HEPA filter change, when dropped or damaged or moved from the project site. Only HEPA systems that pass the challenge DOP testing can be used on the project. All HEPA equipment shall be tested per ANSI/ASME N510 Section 10 to ensure 99.97% efficiency at 0.3 micrometer mean aerodynamic diameter.

2. The entire piece of HEPA equipment shall be challenge tested, not just the filter media. The University’s Consultant or EH&S shall witness the HEPA challenge testing procedure in entirety. Once the HEPA system passes the challenge testing and passes, the HEPA equipment may be used at the location tested for a period not to exceed one year. The testing label shall remain on the HEPA equipment and remain legible. Re-testing of the HEPA equipment is required annually, if the piece of equipment is transported out of the building to another
building location on the campus, if dropped, or otherwise subjected to forces that might unseat the HEPA filter, damaged by water or laceration of the filter or if HEPA filter maintenance or adjustments are performed.

3. When utilizing HEPA Filtered Vacuums for glove boxes or shrouded tools these HEPA Vacuums must be DOP tested.

3.04 NEGATIVE AIR MONITORING CRITERIA

A. Fully Monitored Negative Air Maintaining -0.020" Water Column (in-WC)

1. Build containment with negative air machines capable of maintaining a pressure differential of -0.020 in-WC across all critical barriers.

2. Demonstrate negative pressure is achieved continuously (24/7) by means of an electronic manometer sensitive to measure down to -0.020" wp. An Omniguard IV recording manometer is recommended as the standard instrument for containment pressure monitoring, but other electronic manufactured models with similar sensitivities at low pressures and recording capabilities are acceptable.

B. Hybrid Monitoring and Visual Verification

1. Build containment with negative air machines capable of maintaining a pressure differential of -0.020 in-WC across all critical barriers.

2. During the course of construction, the scope of work may dictate removal of work (e.g. Ceilings or drywall) that would make it difficult to maintain -0.02 in-WC of negative pressure. During working hours Visual Verification of negative pressure may be used in lieu of the -0.02 in-WC requirement with electronic monitoring.

3. At the end of shift all openings must be sealed to bring the containment back to the -0.020 in-WC requirement.

C. Visual Verification

1. The containment shall be visually inspected to verify the plastic is bowed inward to the project area. Tell tail ribbon may also be used to confirm negative pressurization. Visual Verification of negative pressure without the use of a manometer shall be performed upon first entry to the work area, during the course of the work, especially if there are any changes to the work space that may change the negative pressure, prior to taking any breaks and at the end of the work period.

3.05 ADDITIONAL CONTAINMENT CRITERIA

A. Ante Room

1. An ante room is a separate chamber attached to the containment area with zippered doors to allow entry and exit into the containment area. Entry into the containment area shall be only via the ante room. The ante room is commonly constructed of zip poles or equivalent, plastic and tape. The ante room is sized for each project to allow workers and equipment to be moved into and out of the containment area. A sticky mat is required in the ante room for workers and carts on wheels to use when exiting the ante room from the containment area. The
zippered doors are to remain closed or adjusted slightly open as necessary to allow negative pressure to be maintained at least -0.020 in-WC.

2. The ante room shall have a sticky mat present which is intended to remove any debris from the bottom of work shoes before leaving the ante room into the public area. The sticky mat is not intended to clean debris from the bottom of disposable coveralls or from booties. The sticky mat layers shall be replaced many times during a work shift when work involves movement of many workers and supplies out of the containment area. The contractor is responsible for removing a dirty sticky mat and replacing it with a clean one when it is necessary.

3. Workers entering into the containment area will put on a full body disposable coverall with booties inside of the ante room before entering the containment area. Entry into the ante room requires one of the two zippered doors to be opened at one time to maintain the required negative pressure. After entering the ante room, the zipper shall be closed before leaving the ante room into the containment area.

B. Air Scrubbing

1. The contractor shall place additional HEPA filtered fan units (negative air unit) inside of the project work area and operate them in recirculation mode or "scrub mode" near the final cleaning phase of the project to aide in additional particulate cleaning of the space. These units will circulate air internal to the containment area and scrub the air to reduce the total airborne particle concentrations inside of the containment area.

C. Disposable Coveralls and Booties

1. Disposable coveralls are required in all Class III and IV containment areas and selected to provide protection of street clothes from particulates generated inside of the containment area. Disposable coveralls shall be changed if they become ripped and are no longer serviceable.

2. Proper use of the disposable coveralls, booties and use of the sticky mat shall be followed at all times for all workers and UCDMC employees, when it is required by the ICRA Permit. At no time shall workers leave the containment area wearing disposable coveralls and booties. They are to be removed in the ante room or immediately in front of the ante room within the containment area if it is free and clean of debris. The workers shall remove all disposable coveralls and booties and place them in the plastic garbage bag and leave the ante room after walking on the sticky mat.

3.06 CONTAINMENT SET UP

A. Notify UCDHS Representative forty eight (48) hours prior to containment set up.

B. Build containment in compliance with ICRA, drawings and plans.

C. Notify UCDHS Representative and EH&S for inspection prior to start of work. Before any demolition or construction begins, all Protection Areas (infection control areas), control measures put in place and work plan by the Contractor will be inspected by the UCDMC Environmental Health & Safety Personnel, or by a designated representative of UCDMC. Work cannot begin until the containment area has been inspected and approved, meeting all of the provisions of the ICRA Permit.
3.07 REMOVAL OF CONTAINMENT

A. Provide thorough cleaning of existing surfaces, which become exposed to dust, before leaving the containment area and before allowing staff and the public access to the project area.

B. Final cleaning of the containment area requires diligent HEPA vacuuming of all horizontal surfaces and wet wiping all surfaces. Clean towels, sponges, cloth rags or other means shall be used with clean water to effectively clean all surfaces within the containment area. Use of a measured solution of an EPA Listed Germicide is required as part of the final detail cleaning.

C. Additional HEPA filtered negative air units may be installed for scrubbing of particles (see 3.05 B).

D. Coordinate with the UCDHS Representative to call for a final visual inspection of the containment area. The final visual inspection will be made after the contractor has thoroughly cleaned the entire containment area. The contractor will be allowed to remove the containment barriers after the interior has passed the visual inspection for cleanliness.

E. Particle count assessment may be made inside of the containment area by the University’s Representative as part of the final visual inspection process in addition to the final visual inspection. Particle testing will include testing the airborne concentration of various particle sizes compared to the concentration outside of the containment area. If particle counts inside of the containment area are significantly greater than outside of the containment area, the contractor shall continue to scrub the air inside of the project area with HEPA filtered negative air units and conduct additional surface cleaning until subsequent particle testing has demonstrated particle concentrations inside of the containment area are not significantly greater than particle concentrations immediately outside of the containment area.

3.08 ENTRY/EGRESS

A. Entry into the project containment area shall be through the ante room. Entry into the ante room requires one of the two zippered doors to be opened at one time to maintain the required negative pressure. After entering the ante room, the zipper shall be closed before leaving the ante room into the containment area. Equipment and supplies brought into the containment area shall be in sealed leak tight containers inside of rolling covered carts. Equipment, tools and supplies brought into the building shall be clean and free of dust, debris, mold and other contaminants. Cardboard products shall not be brought into the containment area if they are water damaged or have suspect mold growth.

B. All HEPA equipment when transported into and out of the containment area shall be cleaned of all debris on the surfaces and shall have the intake openings sealed with plastic and duct tape.

C. All workers leaving the containment area shall leave in clean clothes. At no time shall disposable coveralls or booties be worn when leaving the containment area through the ante-room into the public area. The workers shall clean all gross particulate debris from the coveralls using a HEPA filtered vacuum. Disposable coveralls can be taken off after gross debris has been removed from the disposable coveralls. The worker shall remove the disposable coverall inside of the ante room by rolling the disposable coverall inside out and then place it into a garbage container (plastic bag) located inside of the ante room or just inside of the project work area.
D. All equipment and supplies leaving the containment area shall be cleaned of all dust and debris before leaving the containment area. Removal of supplies, materials and waste debris from the containment area shall be using tightly covered containers/carts that contain the waste material. The wheels of carts shall be cleaned on a frequent schedule to minimize track-out of debris as they are removed from the containment area. All waste material shall be in sealed leak tight containers. If plastic bags are used, they shall be 6 mil thick at a minimum.

3.09 ENFORCEMENT

A. Failure to maintain required containment will result in issuance of written warning; if situation is not corrected within eight (8) hours of receipt of warning, University will have cause to stop the work as provided in Article 2.1 (if Brief Form) or 2.3 (if Long Form) of the General Conditions. Any egregious violation of safety requirements shall be grounds for Immediate Work Stoppage.

END OF SECTION 01 56 10
Infection Control Risk Assessment
Cover Sheet page (1 of 6)

Submitted by: __________________ Date:____________

Phone: _____________ Fax: _____________

Bldg: ________ Rm: ________

Area Type (Pt. Room, Office, Storage, Hallway, Utility, etc.): ________________________________

Brief Job Description: ________________________________

_____________________________________________________________________________________

Estimated Date Work Starts: ___________

Estimated Duration of Work: ___________
Infection Control Risk Assessment  
Matrix of Precautions for Construction & Renovation

Step One:  
Using the following table, identify the **Type of Construction Project Activity (Type A-D)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TYPE A</strong></td>
<td>Inspection and Non-Invasive Activities. Includes, but is not limited to:</td>
</tr>
<tr>
<td></td>
<td>f removal of ceiling tiles for visual inspection only, e.g., limited to 1 tile per 50 square feet</td>
</tr>
<tr>
<td></td>
<td>f painting (but not sanding)</td>
</tr>
<tr>
<td></td>
<td>f wallcovering, electrical trim work, minor plumbing, and activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.</td>
</tr>
<tr>
<td><strong>TYPE B</strong></td>
<td>Small scale, short duration activities which create minimal dust</td>
</tr>
<tr>
<td></td>
<td>Includes, but is not limited to:</td>
</tr>
<tr>
<td></td>
<td>f installation of telephone and computer cabling</td>
</tr>
<tr>
<td></td>
<td>f access to chase spaces</td>
</tr>
<tr>
<td></td>
<td>f cutting of walls or ceiling where dust migration can be controlled.</td>
</tr>
<tr>
<td><strong>TYPE C</strong></td>
<td>Work that generates a moderate to high level of dust or requires demolition or removal of any fixed building components or assemblies</td>
</tr>
<tr>
<td></td>
<td>Includes, but is not limited to:</td>
</tr>
<tr>
<td></td>
<td>f sanding of walls for painting or wall covering</td>
</tr>
<tr>
<td></td>
<td>f removal of floorcoverings, ceiling tiles and casework</td>
</tr>
<tr>
<td></td>
<td>f new wall construction</td>
</tr>
<tr>
<td></td>
<td>f minor duct work or electrical work above ceilings</td>
</tr>
<tr>
<td></td>
<td>f major cabling activities</td>
</tr>
<tr>
<td></td>
<td>f any activity which cannot be completed within a single workshift.</td>
</tr>
<tr>
<td><strong>TYPE D</strong></td>
<td>Major demolition and construction projects</td>
</tr>
<tr>
<td></td>
<td>Includes, but is not limited to:</td>
</tr>
<tr>
<td></td>
<td>f activities which require consecutive work shifts</td>
</tr>
<tr>
<td></td>
<td>f requires heavy demolition or removal of a complete cabling system</td>
</tr>
<tr>
<td></td>
<td>f new construction.</td>
</tr>
</tbody>
</table>

Step 1: **Type D**
Step Two:
Using the following table, identify the Patient Risk Groups that will be affected.
If more than one risk group will be affected, select the higher risk group:

<table>
<thead>
<tr>
<th>Low Risk</th>
<th>Medium Risk</th>
<th>High Risk</th>
<th>Highest Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>f Office areas</td>
<td>f Cardiology</td>
<td>f CCU</td>
<td>f Any area caring for immunocompromised patients</td>
</tr>
<tr>
<td>f Echocardiography</td>
<td>f Emergency Room</td>
<td>f Emergency Room</td>
<td>f Burn Unit</td>
</tr>
<tr>
<td>f Endoscopy</td>
<td>f Labor &amp; Delivery</td>
<td>f Labor &amp; Delivery</td>
<td>f Cardiac Cath Lab</td>
</tr>
<tr>
<td>f Nuclear Medicine</td>
<td>f Laboratories</td>
<td>f Laboratories</td>
<td>f Central Sterile Supply</td>
</tr>
<tr>
<td>f Physical Therapy</td>
<td>f Medical Units</td>
<td>f Medical Units</td>
<td>f Intensive Care Units</td>
</tr>
<tr>
<td>f Radiology/MRI</td>
<td>f Newborn Nursery</td>
<td>f Newborn Nursery</td>
<td>f Negative pressure isolation rooms</td>
</tr>
<tr>
<td>f Respiratory Therapy</td>
<td>f Outpatient Surgery</td>
<td>f Outpatient Surgery</td>
<td>f Oncology</td>
</tr>
<tr>
<td></td>
<td>f Pediatrics</td>
<td></td>
<td>f Operating rooms including C-section rooms</td>
</tr>
</tbody>
</table>

Step 2 **High Risk - Project varies from Low to high depending on task and location**

Step Three: Match the Patient Risk Group (Low, Medium, High, Highest) with the planned … Construction Project Type (A, B, C, D) on the following matrix, to find the …
Class of Precautions (I, II, III or IV) or level of infection control activities required.
Class I-IV or Color-Coded Precautions are delineated on the following page.

**IC Matrix - Class of Precautions: Construction Project by Patient Risk**

<table>
<thead>
<tr>
<th>Patient Risk Group</th>
<th>Construction Project Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TYPE A</td>
</tr>
<tr>
<td>LOW Risk Group</td>
<td>I</td>
</tr>
<tr>
<td>MEDIUM Risk Group</td>
<td>I</td>
</tr>
<tr>
<td>HIGH Risk Group</td>
<td>I</td>
</tr>
<tr>
<td>HIGHEST Risk Group</td>
<td>II</td>
</tr>
</tbody>
</table>

Note: Infection Control approval will be required when the Construction Activity and Risk Level indicate that Class III or Class IV control procedures are necessary.

Step 3 **IV**
# Description of Required Infection Control Precautions by Class

## During Construction Project

| CLASS I | 1. Execute work by methods to minimize raising dust from construction operations.  
2. Immediately replace a ceiling tile displaced for visual inspection |
| CLASS II | 1. Provide active means to prevent airborne dust from dispersing into atmosphere.  
2. Water mist work surfaces to control dust while cutting.  
3. Seal unused doors with duct tape.  
4. Block off and seal air vents.  
5. Place dust mat at entrance and exit of work area  
6. Remove or isolate HVAC system in areas where work is being performed. |
| CLASS III | 1. Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system.  
2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins.  
3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.  
5. Cover transport receptacles or carts. Tape covering unless solid lid. |
| CLASS IV | 1. Isolate HVAC system in area where work is being done to prevent contamination of duct system.  
2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins.  
3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.  
4. Seal holes, pipes, conduits, and punctures.  
5. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site.  
6. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area. |

## Upon Completion of Project

| CLASS I | 1. Clean work area upon completion of task. |
| CLASS II | 1. Wipe work surfaces with cleaner/disinfectant.  
2. Contain construction waste before transport in tightly covered containers.  
3. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area.  
4. Upon completion, restore HVAC system where work was performed. |
| CLASS III | 1. Do not remove barriers from work area until completed project is inspected by the owner’s Safety Department and Infection Prevention & Control Department and thoroughly cleaned by the owner’s Environmental Services Department.  
2. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction.  
3. Vacuum work area with HEPA filtered vacuums.  
4. Wet mop area with cleaner/disinfectant.  
5. Upon completion, restore HVAC system where work was performed. |
| CLASS IV | 1. Do not remove barriers from work area until completed project is inspected by the owner’s Safety Department and Infection Prevention & Control Department and thoroughly cleaned by the owner’s Environmental Services Dept.  
2. Remove barrier material carefully to minimize spreading of dirt and debris associated with construction.  
3. Contain construction waste before transport in tightly covered containers.  
4. Cover transport receptacles or carts. Tape covering unless solid lid.  
5. Vacuum work area with HEPA filtered vacuums.  
6. Wet mop area with cleaner/disinfectant.  
7. Upon completion, restore HVAC system where work was performed. |
Step 4. Identify the areas surrounding the project area, assessing potential impact

<table>
<thead>
<tr>
<th>Unit Below</th>
<th>Unit Above</th>
<th>Lateral</th>
<th>Lateral</th>
<th>Behind</th>
<th>Front</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varies</td>
<td>Varies</td>
<td>Varies</td>
<td>Varies</td>
<td>Varies</td>
<td>Varies</td>
</tr>
<tr>
<td>Risk Group</td>
<td>Risk Group</td>
<td>Risk Group</td>
<td>Risk Group</td>
<td>Risk Group</td>
<td>Risk Group</td>
</tr>
</tbody>
</table>

Step 5. Identify specific site of activity e.g., patient rooms, medication room, etc.
Various location in the East Wing predominately along the west elevations

Step 6. Identify issues related to: ventilation, plumbing, electrical in terms of the occurrence of probable outages.
HVAC, Plumbing, electrical, Data, telecom, pneumatic tube and steam systems

Step 7. Identify containment measures, using prior assessment. What types of barriers? (E.g., solids wall barriers); Will HEPA filtration be required?
Critical barriers from class 4 to class 1 depending on task and location
(Note: Renovation/construction area shall be isolated from the occupied areas during construction and shall be negative with respect to surrounding areas)

Step 8. Consider potential risk of water damage. Is there a risk due to compromising structural integrity? (e.g., wall, ceiling, roof)
No risk to building structural integrity in this scope of work in this

Step 9. Work hours: Can or will the work be done during non-patient care hours?
Work will generally be performed from 7 am to 4 pm M-F

Step 10. Do plans allow for adequate number of isolation/negative airflow rooms?
Yes

Step 11. Do the plans allow for the required number & type of handwashing sinks?
N/A

Step 12. Does the infection prevention & control staff agree with the minimum number of sinks for this project? (Verify against FGI Design and Construction Guidelines for types and area)
N/A

Step 13. Does the infection prevention & control staff agree with the plans relative to clean and soiled utility rooms?
N/A

Step 14. Plan to discuss the following containment issues with the project team.
E.g., traffic flow, housekeeping, debris removal (how and when),

Contractor will fabricate and maintain containment in accordance with Infection Prevention guidelines as described

Appendix: Identify and communicate the responsibility for project monitoring that includes infection prevention & control concerns and risks. The ICRA may be modified throughout the project. Revisions must be communicated to the Project Manager.
# Infection Control Construction Permit (Post @ Job Site)

<table>
<thead>
<tr>
<th>Location of Construction:</th>
<th>East Wing tower all floors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Coordinator:</td>
<td>Dave Brooks</td>
</tr>
<tr>
<td>Contractor Performing Work</td>
<td>TBD</td>
</tr>
<tr>
<td>Supervisor:</td>
<td>TBD</td>
</tr>
<tr>
<td>Permit No:</td>
<td></td>
</tr>
<tr>
<td>Project Start Date:</td>
<td>TBD</td>
</tr>
<tr>
<td>Estimated Duration:</td>
<td>24 months</td>
</tr>
<tr>
<td>Permit Expiration Date:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
<th>CONSTRUCTION ACTIVITY</th>
<th>YES</th>
<th>NO</th>
<th>INFECTION CONTROL RISK GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td></td>
<td>TYPE A: Inspection, non-invasive activity</td>
<td>X</td>
<td></td>
<td>GROUP 1: Low Risk</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td>TYPE B: Small scale, short duration, moderate to high levels</td>
<td>X</td>
<td></td>
<td>GROUP 2: Medium Risk</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td>TYPE C: Activity generates moderate to high levels of dust, requires greater 1 work shift for completion</td>
<td>X</td>
<td></td>
<td>GROUP 3: Medium/High Risk</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td>TYPE D: Major duration and construction activities Requiring consecutive work shifts</td>
<td>X</td>
<td></td>
<td>GROUP 4: Highest Risk</td>
</tr>
</tbody>
</table>

**CLASS I**
1. Execute work by methods to minimize raising dust from construction operations.
2. Immediately replace any ceiling tile displaced for visual inspection.
3. Minor Demolition for Remodeling

**CLASS II**
1. Provides active means to prevent air-borne dust from dispersing into atmosphere
2. Water mist work surfaces to control dust while cutting.
3. Seal unused doors with duct tape.
4. Block off and seal air vents.
5. Wipe surfaces with cleaner/disinfectant.

**CLASS III**
1. Obtain infection control permit before construction begins.
2. Isolate HVAC system in area where work is being done to prevent contamination of the duct system.
3. Complete all critical barriers or implement control cube method before construction begins.

**DATE**

**Initial**

4. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.
5. Do not remove barriers from work area until complete project is checked by Infection Prevention & Control and thoroughly cleaned by Environmental Services.

**CLASS IV**
1. Obtain infection control permit before construction begins.
2. Isolate HVAC system in area where work is being done to prevent contamination of duct system.
3. Complete all critical barriers or implement control cube method before construction begins.

**DATE**

**Initial**

4. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.
5. Seal holes, pipes, conduits, and punctures appropriately.
6. Do not remove barriers from work area until completed project is checked by Infection Prevention & Control and thoroughly cleaned by Environmental Services.

**Additional Requirements:**
- Execute work by methods to minimize raising dust from construction operations.
- Immediately replace any ceiling tile displaced for visual inspection.
- Provide active means to prevent air-borne dust from dispersing into atmosphere.
- Water mist work surfaces to control dust while cutting.
- Seal unused doors with duct tape.
- Block off and seal air vents.
- Wipe surfaces with cleaner/disinfectant.
- Obtain infection control permit before construction begins.
- Isolate HVAC system in area where work is being done to prevent contamination of the duct system.
- Complete all critical barriers or implement control cube method before construction begins.
- Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.
- Seal holes, pipes, conduits, and punctures appropriately.
- Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave the work site.
- All personnel entering work site are required to wear shoe covers.
- Obtain infection control permit before construction begins.
- Isolate HVAC system in area where work is being done to prevent contamination of duct system.
- Complete all critical barriers or implement control cube method before construction begins.
- Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.
- Seal holes, pipes, conduits, and punctures appropriately.
- Do not remove barriers from work area until completed project is checked by Infection Prevention & Control and thoroughly cleaned by Environmental Services.
- Vacuum work area with HEPA filtered vacuums.
- Wet mop with cleaner/disinfectant.
- Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction.
- Contain construction waste before transport in tightly covered containers.
- Cover transport receptacles or carts. Tape covering.
- Upon completion, restore HVAC system where work was performed.

**Exceptions/Additions to this permit are noted by attached memoranda**

**Permit Request By:**

**Permit Authorized By:** UCDH EH&S Department

<table>
<thead>
<tr>
<th>Date</th>
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</table>
PART 1 – PURPOSE

This section outlines policy and procedures for access to ceiling spaces containing or suspected of containing asbestos fireproofing and/or asbestos thermal insulation.

PART 2 – POLICY

Work that may disturb asbestos but is not intended to result in intentional asbestos removal shall be controlled in accordance with this section as well as Cal/OSHA requirements for Class III asbestos work contained in 8 CCR 1529 and general requirements of 8 CCR 5208. Moving ceiling tiles or horizontal hatches to access ceiling spaces with asbestos fireproofing or containing debris from asbestos thermal insulation is Class III asbestos work. The university representative may approve modifications to these procedures. This section outlines minimum requirements. Controls that exceed these requirements may be used.

PART 3 – PROCEDURES

A. Training

Personnel performing work in spaces containing or suspected of containing asbestos material shall have a minimum of 16 hours of OSHA/EPA certified training for Class III work by an accredited Asbestos Certifying Agency. If the 16 hour training certification is unavailable, then a OSHA/EPA 32 hour Worker Training will have to be obtained. In addition, the Supervisor is required to have a 40 hour Supervisor Training Certification. The OSHA/EPA certified (AHERA) worker or supervisor training qualifies the individual for Class III worker and Class III competent person work.

B. Competent Person

A Competent Person (either AHERA – 40 hour trained or Class III 16 hour trained) shall inspect the area to determine precautions prior to entry, to determine that the controlled area is properly established, and to determine that appropriate cleanup has occurred at the end of the job. The person performing the work may serve as the competent person as well.

C. Standard Access Procedure

1. Mini-enclosure

Use an asbestos mini-enclosure, or an equivalent enclosure constructed on site. Use a HEPA filter vacuum to create a negative pressure in the enclosure. The enclosure must be posted with warning signs bearing the following information: DANGER, ASBESTOS, CANCER AND LUNG DISEASE HAZARD, AUTHORIZED PERSONNEL ONLY. Access into the enclosure must be restricted to trained personnel. Any debris generated by ceiling access must be cleaned up by HEPA vacuum immediately.

Before leaving the enclosure carefully examine clothing and bottoms of shoes and remove any debris with a HEPA vacuum. At the end of the job disposable clothing must be removed at the site and bagged as asbestos waste. Use a labeled asbestos waste bag. Close the bag, label it and ensure it is delivered to the hazardous waste disposal yard. After completion of these procedures for ceiling tile removal, the enclosure may be moved and the ceiling left open until the end of the shift, unless additional requirements are imposed by Infection Control. The same controls used for ceiling tile removal must be used for ceiling tile
replacement. Any debris generated by ceiling tile replacement must be cleaned up by HEPA vacuum immediately. If necessary, the ceiling opening may be closed with plastic sheeting and duct tape.

2. Air sampling
   Periodic air sampling is required when the project requires extensive ceiling access to verify that ceiling tile access is not resulting in elevated asbestos exposures. The air sampling frequency will be established by the University. When this is required the University will provide the air monitoring. When air samples are performed, a 30-minute sample must be collected. If the operation lasts beyond 30 minutes, an additional sample must be collected for the remainder of the operation.

3. Clean up of debris
   All debris shall be cleaned up promptly. The floor of the mini-enclosure shall be HEPA vacuumed before moving.

4. Personal Protective Equipment
   Typical protective equipment for class III work shall be disposable coveralls (e.g., Tyvek) and respirator with HEPA filter cartridges suitable for asbestos protection.

D. Ceiling space crawl where there is asbestos fire proofing or asbestos debris may be present (no abatement work)

1. **Protective equipment** will be as for ceiling access, single layer Tyvek and filtering facepiece respirator required. If employee notices tear of outer coverall during work - use duct tape to repair tears to outer coverall, or exit and replace outer cover. Remove and bag coverall and respirator in mini-enclosure as in ceiling access procedure. If coveralls were torn, vacuum any noticeable debris from underlying clothing. Clothing must be changed at work and may not be taken home.

2. **Control of debris during ceiling crawls.** In all cases vacuum clearly recognizable insulation debris in the immediate area of the ceiling access. If practical, vacuum visible insulation debris for the full path of travel. If this is not practical the employee must use other procedures to ensure safe removal of visible insulation debris in the path of travel that would be disturbed by the crawl. For example, wet paper towels and plastic bags may be used to pick up and contain visible debris. Other control methods may be used provided they meet the following criteria:
   - dry sweeping is not permitted
   - employees must not walk on, crawl on or otherwise crush visible clearly recognizable insulation debris
   - the control method must not result in a release of airborne fibers.

D. **HEPA filter testing and certification**

The HEPA vacuum for ceiling work and HEPA filter for mini-enclosure must have passed DOP testing within 12 months and must be re-certified after filter replacement.

E. **Access for inspection after ceiling tile has been moved and the mini-enclosure removed**

Inspection above the ceiling, after ceiling tile has been moved and the mini-enclosure removed, may be performed without special asbestos awareness training or protective equipment. Access of this type is limited to visual inspection through the ceiling opening. Full entry to the space or ceiling crawl must meet the requirements of paragraphs C and D of this section. Personnel who
perform this work must be notified that asbestos is present in the area and of which materials in
the area contain asbestos.

G. Asbestos Waste Management

Personnel are required to appropriately bag all asbestos debris, disposable personal protective
equipment, and other materials potentially contaminated with asbestos. Bags shall be clear, 6 mil,
imprinted with the required asbestos warning. Appropriate packaging includes double-bagging,
and wetting the materials in the inner bag. Each bag shall be legibly marked with the UC Davis
Medical Center address and EPA ID number (CAD 076124981).

For those projects generating five (5) or fewer bags of asbestos-contaminated materials, UCDHS
Environmental Health and Safety (EH&S) will manage the disposal of the bags; contact EH&S at
916-734-2740 for disposal. Materials must be bagged and marked as described above prior to
EH&S acceptance.

Asbestos disposal is the responsibility of the Contractor on those projects generating more than
five (5) bags of asbestos-contaminated material. If a Uniform Hazardous Waste Manifest is
required for transportation, such manifest must be signed by a representative of UCDHS EH&S.

END OF SECTION 01 56 20
1.1 General Provisions Regarding Specification of Products, Material or Equipment By Brand Or Trade Name.

1.1.1 Products, material or equipment specified by both brand or trade name and model number are approved for use, provided that Contractor complies with all Contract requirements. Specification of a product, material or equipment by brand or trade name and model number is not a representation or warranty that the product, material or equipment can be used without modification, to meet the requirements of the plans and specifications; Contractor shall, at its sole cost, modify such products, material, or equipment so that they comply with all requirements of the plans and specifications.

1.1.2 The first-named product, material or equipment specified by brand or trade name and model number is the basis for the Project design and the use of any item other than the first-named one may require modifications of that design. If Contractor uses any product, material or equipment other than the first-named one, Contractor shall, at its sole cost:

1. Make all revisions and modifications to the design and construction of the Work necessitated by the use the product, material or equipment.

2. Be responsible for all costs of any changes resulting from the use of the product, material or equipment including without limitation, costs or changes which affect other parts of the Work, the work of Separate Contractors, or any other property or operations of the University.

1.1.3 When a product, material or equipment specified by brand or trade name is followed by the words “or equal,” a substitution may be permitted if the substitution is equal to or superior to the first-named product, material or equipment in quality, utility and appearance and if the substitution complies with all other requirements of the plans and specifications.

1.1.4 A product, material or equipment specified by brand or trade name followed by the words “or equal, no known equal,” signifies that University does not have sufficient knowledge to specify a product, material or equipment, other than the one specified by brand or trade name, that is suitable for use on the Project. The use of the words “no known equal” is not intended to discourage substitution requests in accordance with the requirements specified herein.

1.1.5 When catalog numbers and specific brands or trade names not followed by the designation "or equal" are used in conjunction with a product, material or equipment required by the specifications, substitutions will not be allowed and the named product, material or equipment must be used.

1.1.6 Specification of a product, material or equipment by brand or trade name and model number is not a representation or warranty that the product, material or equipment is available; Contractor should confirm, prior to submitting its Bid, the availability of any product, material or equipment specified by brand or trade name and model number.

1.2 Special Requirements For Products, Material Or Equipment, Other Than The First-Named Product, Material Or Equipment, Specified By Both Brand Or Trade Name And Model Number.

1.2.1 In addition to complying with all other submittal requirements of the Contract, submit within 70 days after the date of commencement specified in the Notice to Proceed, for review and approval by the University’s Representative, Contractor prepared specifications and drawings,
including design and engineering calculations, prepared by an appropriate licensed professional, depicting all revisions and modifications to the design and construction of the Work necessitated by the use of the product, material or equipment. If no revisions or modifications are necessary, submit within 70 days after the date of commencement specified in the Notice to Proceed, a written representation that no revisions or modifications to the design or construction of the Work are necessitated by the use of the product, material or equipment. Contractor shall utilize the first-named product, material or equipment if Contractor fails to make the appropriate required submittal pursuant to this paragraph within the 70-day period.

1.2.2 A product, material or equipment, other than the first-named product, material or equipment, specified by both brand or trade name and model number may be used if no revisions or modifications to the design or construction of the Work are necessitated by the use of the product, material or equipment. If such revisions or modifications are necessary, the product, material or equipment may be used only if the revisions or modifications are approved in writing by the University’s Representative. Contractor has the burden of demonstrating, through the procedures specified herein, that any such revisions or modifications will not be detrimental to the quality, utility or appearance of the Project or any portion of the Project. The University’s Representative may refuse to approve any such proposed revisions or modifications where, in the reasonable opinion of the University’s Representative, Contractor has failed to demonstrate, through the procedures specified herein, that the revisions or modifications are not detrimental to the quality, utility or appearance of the Project or any portion of the Project.

1.3 Special Requirements For Substitutions.

1.3.1 In addition to complying with all other submittal requirements of the Contract, submit written data demonstrating that the proposed substitution is equal to or superior to the first-named product, material or equipment in quality, utility and appearance and otherwise complies with all requirements of the plans and specifications, including:

.1 Complete technical data including drawings, performance specifications, samples, and test reports of the article proposed for substitution.

.2 Statement by Contractor that the proposed substitution is in full compliance with the requirements of the Contract Documents and Applicable Code Requirements.

.3 List of Subcontractors, if any, that may be affected by the substitution.

.4 Contractor prepared specifications and drawings, including design and engineering calculations, prepared by an appropriately licensed professional, depicting all revisions and modifications to the design and construction of the Work necessitated by the use of the substitution. If no revisions or modifications are necessary, submit a written representation that no revisions or modifications to the design or construction of the Work are necessitated by the use of the product, material or equipment.

1.3.2 At the request of and within the timeframes specified by the University’s Representative:

.1 Submit samples as deemed necessary by the University’s Representative to evaluate the proposed substitution.

.2 Submit proposed substitution to tests deemed necessary by the University’s Representative to evaluate the proposed substitution. Such tests shall be made by an independent Testing Laboratory and at the sole expense of Contractor, after review and approval of the test procedures by University’s Representative. If re-testing is deemed necessary by the University’s Representative to evaluate the proposed substitution, such
re-testing shall be made by an independent Testing Laboratory at the sole expense of the Contractor.

3. Provide any additional information deemed necessary by the University's Representative to evaluate the proposed substitution.

1.3.3 If University's Representative, in reviewing a proposed substitution, requires revisions or corrections to be made to previously accepted shop drawings and supplemental supporting data to be resubmitted, Contractor shall do so within the time period specified by the University's Representative. A proposed substitution may be rejected if Contractor fails to submit such revisions, corrections, or supplemental supporting data within the specified time period.

1.3.4 Except for products, material or equipment designated in the Bidding Documents for evaluation of substitutions prior to award, requests for substitution, including the data required by Paragraph 1.3.1, must be submitted to the University's Representative not later than 35 days after the date of commencement specified in the Notice to Proceed. No requests for substitutions of products, material or equipment subject to the 35-day deadline shall be considered unless the request and supporting data is submitted on or before the deadline, except those deemed, in University's Representative's sole opinion, to be necessary because (i) previously specified or approved manufactured products, material or equipment are no longer manufactured, (ii) of University initiated change orders, or (iii) it is in the best interest of University to accept such substitution.

1.3.5 If a product, material or equipment is designated in the Bidding Documents for evaluation of substitutions prior to award, then a request for substitution of the product, material or equipment, including the data required by Paragraph 1.3.1, must be submitted by the deadline specified in the Bidding Documents. Because of time constraints, only one submittal will be allowed for each such substitution request. Requests for substitutions of products, material or equipment designated for evaluation prior to award may not be made after the deadline specified in the Bidding Documents, and such requests be shall not be considered unless the request and supporting data is submitted on or before the deadline specified in the Bidding Documents. Notwithstanding the forgoing, the University may consider, after award of the Contract, requests for substitution of a product, material or equipment designated for evaluation prior to award where, in University's Representative's sole opinion, a substitution is necessary because (i) previously specified or approved manufactured products, material or equipment are no longer manufactured, (ii) of University initiated change orders, or (iii) it is in the best interest of University to accept such substitution.

1.3.6 In reviewing the supporting data submitted for substitutions, University's Representative will use, for purposes of comparison, all the characteristics of the specified material or equipment as they appear in the manufacturer's published data even though all the characteristics may not have been particularly mentioned in the Specifications. If more than 2 submissions of supporting data are required, the cost of reviewing the additional supporting data shall be at Contractor's expense.

1.3.7 Contractor has the burden of demonstrating, through the procedures specified herein, that its proposed substitution is equal to or superior to the first-named product, material or equipment in quality, utility and appearance and complies with all other requirements of the plans and specifications. If revisions or modifications to the design or construction of the work are necessitated by the use of the substitution, Contractor also has the burden of demonstrating, through the procedures specified herein, that the use of the substitution will not be detrimental to the quality, utility or appearance of the Project or any portion of the Project.

1.3.8 The University's Representative may refuse to approve any requested substitution where, in the reasonable opinion of the University's Representative, Contractor has failed to
demonstrate, through the procedures specified herein, that the proposed substitution is equal to, or superior to, the first-named product, material or equipment, in quality, utility and appearance and that the proposed substitution complies with all other requirements of the plans and specifications.

1.3.9 University's Representative may reject any substitution not proposed in the manner and within the time limits prescribed herein.

1.3.10 Substitutions are not allowed unless approved in writing by the University's Representative. Any such approval shall not relieve Contractor from the requirements of the Contract Documents.

1.3.11 The 35-day and 70-day submittal periods do not excuse Contractor from completing the Work within the Contract Time or excuse Contractor from paying liquidated damages if Final Completion is delayed.

1.3.12 If revisions or modifications to the design or construction of the Work are necessitated by the use of a substitution, the substitution may be used only if the revisions and modifications are approved in writing by the University's Representative. The University's Representative may refuse to approve any such proposed revisions or modifications where, in the reasonable opinion of the University's Representative, Contractor has failed to demonstrate, through the procedures specified herein, that the revisions or modifications are not detrimental to the quality, utility and appearance of the Project or any portion of the Project.

1.3.13 If a substitution request is finally rejected by the University Representative, Contractor shall furnish and install:

.1 the first-named product, material, or equipment; or

.2 a product, material, or equipment, other than the first-named product, material or equipment, specified by both brand or trade name and model number, provided Contractor complies with the submittal requirements (including deadlines) of specification section 01 63 00-1.2

END OF SECTION 01 63 00
REQUEST FOR SUBSTITUTION

Substitution #: _______________  Submittal #: _______________  Date: _______________

A/C #: M030667  OSHPD #: I140010-34-04

PROJECT NAME: Decommission North/South Wing – Increment 4

TO: UC DAVIS HEALTH SYSTEM
FROM: Facilities Design & Construction
4800 2nd Avenue, Suite 3010
Sacramento, CA 95817
P: 916-734-7024
F: 916-734-7751
Attn: Dave Brooks
dcbrooks@ucdavis.edu

Name of Party Submitting Request for Substitution: ____________________________

Reason for Submitting Request for Submission: ________________________________

Specification Section and Paragraph #: ________________________________

Substitution Manufacturer name and address: ________________________________

Proposed substitution (trade name of product, model or catalog #): ______________

Fabricators and Suppliers (as appropriate): ________________________________

PRODUCT DATA:
ATTACH PRODUCT DATA AS SPECIFIED IN SPECIFICATION SECTION 01 33 00 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

Similar projects using product (list dates of installation and names/phone numbers of Owners):

________________________________________________________________________

Similar comparison of proposed substitution with specified product (indicate variation(s), and reference each variation to appropriate Specification Section paragraphs):

-ATTACH COMPARISON SUMMARY-
(SUBSTITUTION REQUEST CONTINUES)

Quality and performance comparison between proposed substitution and specified product:

________________________________________________________________________

________________________________________________________________________

Availability of maintenance services and replacement materials: ________________________

________________________________________________________________________

Effect of proposed substitution on Construction Schedule: ____________________________

________________________________________________________________________

Effect of proposed substitution on other work or products: ____________________________

________________________________________________________________________
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements and limitations for cutting and patching Work.

1.2 RELATED SECTIONS

A. Section 01 11 00 – SUMMARY OF THE WORK
B. Section 01 31 00 – COORDINATION
C. Section 01 33 23 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
D. Section 01 60 00 – PRODUCT REQUIREMENTS
E. Individual Specifications Sections.
   1. Cutting and patching incidental to Work specified in this Section.
   2. Coordination with work in other Sections for openings required to accommodate Work specified in those other Sections.

1.3 SUBMITTALS

A. Contractor shall complete and submit for review to University's Representative, a Coring/Sawcutting Form, included at the end of this Section, and obtain written authorization for University prior to the commencement of any dig activities. Contractor shall include all pertinent information with the Coring/Sawcutting Form and submit with detailed work plan fourteen (14) days prior to desired coring/cutting activity.
   1. Structural integrity of any element of Project.
   2. Integrity of weather-exposed or moisture-resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   5. Work of University.
   6. Utility supply, drains, fire alarm, communication.

B. Include in request:
   1. Identification of Project, including University's Project Name and A/C number.
   2. Location and description of affected Work.
   3. Necessity for cutting and patching.
4. Description of proposed work, and products to be used.
5. Alternatives to cutting and patching.
6. Effect on work of University.
7. Written permission of University.
8. Date and time work will be executed.

1.4 NOTIFICATIONS

A. Before starting welding or cutting work involving the use of gas or electric welding equipment, or any brazing work involving gas or electric brazing equipment Contractor shall complete Hazardous Conditions Permit form located at the back of this Section. Incomplete forms will be returned as non-compliant and no permit will be issued. Contractor shall allow seventy-two (72) Hours for Fire marshal's approval and issuance of Hazardous Conditions Permit. This permit will be issued without cost to Contractor and may be applicable to more than one (1) building. Contractor shall be responsible for reporting to Fire Department either by telephone or in person at beginning and end of each day's work. Provide minimum written notice of fourteen (14) calendar days prior to such activities.

1. Faxed applications for Hazardous Conditions Permit will be accepted. University's Representative fax number is 916-734-7751
2. Welding and brazing personnel must be certified by a University or OSHPD approved laboratory and must maintain this certification during the work of this Contract.
3. Contractor is responsible for notifying University of all apparent locations of Asbestos. When any such location is discovered by Contractor, information relating thereto shall be immediately communicated to University's Representative at 916-734-7024.
4. Contractor shall then follow any and all instructions as indicated by University's Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Product substitution: For any proposed change in materials, submit request for substitution under provision of SECTION 01 60 00 – PRODUCT REQUIREMENTS.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Execute cutting, fitting and patching including excavation and fill, to complete Work and:
   1. Fit the several parts together, to integrate with other work.
   2. Uncover work to install ill-timed work.
3. Remove and replace defective and non-conforming work.

4. Remove samples of installed work for testing.

5. Provide openings in elements of Work for penetrations of mechanical and electrical work.

B. Examination, General: Inspect existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.

1. After uncovering existing Work, inspect conditions affecting proper accomplishment of Work.

2. Beginning of cutting or patching shall be interpreted to mean that existing conditions were found acceptable by Contractor.

C. Ground Penetrating Radar: Determine by Ground Penetrating Radar all existing reinforcing, conduit and piping located in concrete walls and slabs prior to demolition. Clearly mark all locations and review with University Representative prior to demolition.

3.2 PREPARATION

A. Temporary Supports: Provide supports to assure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.

B. Weather Protection: Provide protection from elements in all areas that may be exposed by uncovering work. Maintain excavations free of water.

3.3 CUTTING AND PATCHING

A. Execute cutting, fitting, and patching to properly complete Work.

B. Coordinate installation or application of products for integrated Work.

C. Uncover completed Work as necessary to install or apply products out of sequence.

D. Remove and replace defective or non-conforming Work.

E. Provide openings in the Work for penetrations of mechanical and electrical Work.

3.4 PERFORMANCE

A. Execute cutting and patching by methods to avoid damage to adjoining Work, and that will provide appropriate surfaces to receive final finishing.

B. Execute cutting and patching of weather-exposed, moisture-resistant and sight-exposed surfaces by methods to preserve weather, moisture and visual integrity.

C. Restore work with new Products as specified in individual Sections of Contract Documents.

D. Cut rigid materials using masonry saw or core drill. Pneumatic tools are not allowed without prior approval from University. Coordinate timing of all sawing and cutting work with the University’s Representative.
E. Fit work neat and tight allowing for expansion and contraction. Butt new finishes to existing exposed structure, pipes, ducts, conduit, and other penetrations through surfaces.

F. At penetrations of firewalls, partitions, ceiling, or floor construction, completely seal voids with UL approved fire-rated assembly. Provide temporary closures at the end of each work day. Closures shall be approved by the University Fire Marshal.

G. Refinish surface to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish unit.

H. Where new construction is to join with or match existing work, it shall be finished exactly to that work so as to form a complete unified and finished element.

END OF SECTION 01 73 29
UNIVERSITY FIRE DEPARTMENT
APPLICATION FOR HAZARDOUS CONDITIONS PERMIT

A/C #: _______________ OSHPD #: _______________ UCDMC HCP #: _______________

PROJECT NAME: ____________________________________________
CONTRACTOR: ____________________________________________
CONTRACTOR HCP #: _______________

TO: UC DAVIS HEALTH SYSTEM

FROM: ______________________________________
Facilities Design & Construction
4800 2ND Avenue, Suite 3010
Sacramento, CA 95817
P: 916-734-7024
F: 916-734-7751
Attn.: (Project Manager)

NAME: __________________________________ DATE: ____________
TITLE: ____________________________________________
COMPANY: _______________________________________
PHONE NO.: _____________________________________
LOCATION OF WORK: _______________________________
START DATE/TIME: _______________ FINISH DATE/TIME: _______________

Hereby makes application for a permit to maintain, store, use or handle materials or to conduct processes which produce conditions potentially hazardous to life and property as describe below:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

The Fire Chief, or authorized representative, will inspect the above receptacles, vehicles, buildings, devices, storage spaces or areas to be used for their conformance to the Fire and Life Safety Regulations contained in the University of California, Davis Campus Policy and Procedure manual and Title 19, C.A.C.

APPROVED: _______________________ TITLE: ______________________ DATE: _______________

IF DENIED, EXPLANATION WILL BE GIVEN ON THE BACK OF THIS FORM.
**CORING / SAWCUTTING NOTIFICATION**

<table>
<thead>
<tr>
<th>LOCATION:</th>
<th>A/C:</th>
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<tr>
<td>TRACKING NUMBER:</td>
<td>TITLE:</td>
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<tr>
<td>OSHPD #:</td>
<td>DATE:</td>
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</tbody>
</table>

**TO:** UC DAVIS HEALTH SYSTEM  
Facilities Design & Construction  
4800 2nd Avenue, Suite 3010  
Sacramento, CA 95817  
P: 916-734-7024  
F: 916-734-7751  

Attn.: [Project Manager]

**FROM:**

**SCOPE:**

**HAS USA BEEN NOTIFIED?**  
☐ YES  ☐ NO  

**ARE ALL KNOWN UTILITIES MARKED?**  
☐ YES  ☐ NO  

**LOCATION OF WORK SHOWN ON ATTACHED SITE PLANS?**  
☐ YES  ☐ NO

**DATE(S) CORING OR SAWCUTTING WILL TAKE PLACE:**

Signed:______________________________

UCDMC USE ONLY

**DATE RECEIVED:**

**WHO FROM UCDMC WILL AUTHORIZE, SUPERVISE AND VERIFY?**

**PHONE:**

Utilities Verified by IOR?  
☐ YES  ☐ NO

Activities coordinated with:  
☐ PO&M  ☐ Fire  ☐ Telecom  ☐ Occ. Safety  
☐ Other (Itemize):

**COMMENTS:**

Signed:______________________________

**DATE AUTHORIZED:**

[University Representative]  
PO&M:  

**COMPLETION DATE:**

**COMMENTS:**

(Unknown Utilities Encountered, Disruptions, Successes, Weather, etc.)

SIGNED:______________________________

Copies to: University Consultants, PO&M, Fire, Telecom, File, Others:
SECTION 01 74 00
CLEANING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Construction Cleaning.

B. Requirements for cleaning during progress of Work, at Substantial Completion of Work and at Acceptance of Work.

C. Disposal of waste materials, debris and rubbish during construction.

1.2 RELATED SECTIONS

A. General Conditions of the Contract: Cleanup.

B. Additional Requirements: Cleaning for specific products or elements of Work are described in Specification Sections describing that Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use only those cleaning agents and materials that will not create hazards to health or property and that will not damage surfaces.

B. Use only those cleaning agents, materials and methods recommended by manufacturer of the material to be cleaned.

C. Use cleaning materials only on surfaces recommended by cleaning agent manufacturer.

2.2 EQUIPMENT

A. Provide covered containers for deposit of waste materials, debris, and rubbish.

B. Provide at each entry point to the Work, and at other areas as directed by University's Representative, Dryden Engineering, "Micro-Clean Adhesive Mat, #TS/1847", or equal (no known equal). Replace mats daily or as requested by University Representative.

PART 3 - EXECUTION

3.1 CLEANING

A. Construction Cleaning: During Construction, maintain buildings, premises and property free from waste materials and rubbish. Dispose of such waste and debris at reasonable intervals off of University property.

1. Maintain areas under Contractor's control free of waste materials, debris and rubbish. Maintain site in a clean and orderly condition.

2. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to closing such spaces.
3. Clean interior areas daily to provide suitable conditions for Work. Remove debris from areas of work on a daily basis at a minimum, or more often as required to provide suitable conditions for work.

4. Broom clean interior areas prior to start of surface finishing, and continue cleaning on as needed basis.

5. Control cleaning operations so that dust and other particles will not adhere to wet or newly-coated surfaces.

6. Provide a mat, as specified above, for project entrances and exits. Item to be of sufficient size to allow personnel exiting project site to clean debris and dust from shoes. Tracking dust and debris through working areas of hospital and/or related buildings is not acceptable. Any dust or debris tracked out of construction site, either by foot traffic or by debris hauling vehicles, at University option, shall be cleaned and removed by Contractor at no additional cost to the University.

B. Conduct cleaning and disposal operations in compliance with all applicable codes, ordinances, regulations, including anti-pollution laws.

3.2 SUBSTANTIAL COMPLETION CLEANING

A. Execute a thorough cleaning prior to Substantial Completion review by University's Representative.

B. Clean walkways, driveways and streets by thorough brooming and wash-down.

C. Clear debris from storm drainage lines and ways, leaving site ready for stormy weather.

D. Rake landscaped areas clean.

E. Remove waste and surplus materials, rubbish and temporary construction facilities, utilities and controls.

F. Disinfect containment and protection areas as directed by University Representative.

G. For Airborne Contamination areas: Construction cleaning use wet cleaning methods and HEPA-filtered vacuum cleaners are required to minimize release of airborne contaminants. Contain waste materials, debris and rubbish.

3.3 FINAL COMPLETION CLEANING

A. Complete final cleaning before submitting final Application for Payment.

B. Employ professional building cleaners to thoroughly clean building immediately prior to final inspection.

C. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from all sight-exposed interior and exterior surfaces.

D. Restore damaged or marred surfaces.

E. Remove dust from all horizontal surfaces not exposed to view, including light fixtures, ledges and fixture lenses.
F. Clean and polish all glass, mirrors, and bright metal work. Clean and disinfect all plumbing fixtures.

G. Damp wash all resilient flooring. Waxing of resilient flooring shall be done by the University.

H. Thoroughly sweep all floors and vacuum all carpets. Cleaning of Work provided by University under separate contracts, will not be required except if soiled by construction activities under this Contract.

I. Thoroughly clean and polish all resilient flooring, metal and plastic surfaces; remove labels and protective coatings.

J. Replace filters and clean heating and ventilating equipment used for temporary heat and ventilation.

K. Remove waste material or equipment that has been damaged, touch up and /or repair exposed areas; such repairs to be approved by University's Representative.

L. Should final cleaning be inadequate, as determined by University's Representative, and Contractor fails to correct conditions, University's Representative may order thorough cleaning and deduct the cost from Final Payment.

3.4 FINAL COMPLETION SITE CLEANING

A. Broom clean exterior paved surfaces. Rake clean other surfaces of the grounds.

B. Hose down and scrub where necessary all concrete and walks dirtied as a result of the construction work. Thoroughly remove mortar droppings from all walks and pavements.

C. Remove from the site all tools, equipment, construction waste, unused materials, excess earth, and all debris resulting from the Work.

3.5 DISPOSAL

A. Conduct cleaning and disposal operations in compliance with all applicable codes, ordinances, regulations, including anti-pollution laws.

B. Do not bury or burn rubbish or waste material on University premises.

C. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains.

D. Remove waste materials, debris, and rubbish from site and dispose of off-site.

3.6 INSPECTION

A. Prior to final completion or University use of premises, Contractor and University's Representative shall jointly conduct an inspection of sight-exposed interior and exterior surfaces to verify that entire Work is clean.

END OF SECTION 01 74 00
SECTIOII 01 75 00
STARTING AND ADJUSTING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Procedures for Starting Systems.

1.2 RELATED SECTIONS

A. Section 01 86 00 – PLUMBING/HVAC TESTING PROCEDURES
B. Section 01 79 00 – DEMONSTRATION AND TRAINING

1.3 SUBMITTAL REQUIREMENTS

A. Submit preliminary schedule listing times and dates for start-up of each item of equipment in sequence in writing, minimum of fourteen (14) calendar days prior to any start-up.
B. Submit manufacturer’s representative reports within one (1) week after start-up, listing satisfactory start-up dates.

1.4 PROJECT CONDITIONS

A. Building enclosure shall be complete and weather-tight.
B. Excess packing and shipping bolts shall be removed.
C. Interdependent systems shall have been checked and made operational.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify Project conditions comply with requirements for start-up.
B. Verify status of Work meets requirements for starting equipment and systems.

3.2 PREPARATION

A. Coordination: Coordinate sequence for start-up of various item of equipment.
B. Notification: Notify University in writing, minimum of fourteen (14) calendar days prior to start-up of each item of equipment.
C. Information on hand: Have Contract Documents, shop drawings, product data, and operation and maintenance data at hand during entire start-up process.
D. Verify each piece of equipment has been checked for proper lubrication, drive rotation, belt tension, control sequence, and other conditions that may cause damage.
E. Verify control systems are fully operational in automatic mode.

F. Manufacturer's Criteria: Verify tests, meter readings and specific electrical characteristics agree with electrical equipment manufacturers' criteria.

G. Bearings: Inspect for cleanliness: clean and remove foreign matter, verify alignment. Take corrective action as required.

H. Drives: Inspect for tension on belt drives, adjustment of vari-pitch sheaves and drives, alignment, proper equipment speed, and cleanliness. Take corrective action as required.

I. Motors: Verify motor amperage agrees with nameplate value. Inspect for conditions that produce excessive current flow and that exist due to equipment malfunction. Take corrective action as required.

3.3 STARTING SYSTEMS

A. Execute start-up under supervision of responsible Contractor personnel.

B. Place equipment in operation in proper sequence in accordance with sequencing schedule.

END OF SECTION 01 75 00
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Protection for Products Including University Provided Products, After Installation.

B. Protection of Existing Utilities and Interference.

1.2 RELATED SECTIONS

A. Section 01 31 00 – COORDINATION

B. Section 01 51 00 – TEMPORARY UTILITIES

1.3 EXISTING UTILITIES

A. Known Utilities: Known existing utilities are shown on Contract Drawings in approximate locations. Contractor shall exercise care in avoiding damage to existing facilities. Contractor shall be responsible for repair of same if damaged through Contractor's action. Hand excavation shall be utilized when digging in close proximity to existing utilities. University does not guarantee that all utilities or obstructions are shown, or that locations indicated are accurate.

B. Electrical Equipment: No work shall be performed on energized electrical equipment unless scheduled with University's Representative. University reserves right to specify specific conditions for all work involving energized high voltage electrical equipment and its scheduled modification proposal.

C. Uncovering Facilities: Prior to any earthwork for new construction, Contractor shall uncover all existing piping where crossings, interferences or connections are shown on Contract Drawings, from one (1) foot below proposed construction limit to the existing ground surface. Any variation in actual elevations and indicated elevations shall be brought to University's Representative attention. If Contractor does not expose all existing utilities, Contractor shall not be entitled to additional compensation for work necessary to avoid unknown interferences.

D. Interferences: If interferences occur at locations other than general locations shown on Contract Drawings, and such utilities are damaged before such locations have been established, or create an interference, Contractor shall immediately notify University's Representative and a method for correcting said interference shall be supplied by University. Payment for additional work due to interferences not shown on Contract Drawings shall be in accordance with the General Conditions of the Contract. Cost of repair to damaged utilities shall be deducted from the Contract Sum.

E. Accuracy of Drawings: Drawings showing location of equipment, piping, etc. are diagrammatic and job conditions will not always permit installations in locations shown. When a conflict situation occurs, immediately bring to attention of University's Representative for determination of relocation.

F. Deviations from Drawings: Information shown relative to existing power and signal service is based upon available records and data but shall be regarded as approximate
only. Minor deviations found necessary to conform with actual locations and conditions shall be made at no change to the Contract Sum.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION

3.1 PROTECTION AFTER INSTALLATION

A. Installed Equipment and Materials: Adequately protect all installed equipment and materials until completion and acceptance by University's Representative.

B. Existing Facilities: All existing improvements and facilities shall be protected from damage of any type resulting from operations, equipment or workers of Contractor during the construction process.

C. Subsequent Operations: Protect installed products and control traffic in immediate area to prevent damage from subsequent operations.

D. Traffic Areas: Provide protective coverings at walls, projections, corners, and jambs, sills, and soffits of openings in and adjacent to traffic areas.

E. Elevators: Cover walls and floors of elevator cabs, and jambs of cab doors, when elevators are used by construction personnel.

F. Finished Floors: Protect finished floors and stairs from dirt, wear, and damage:
   1. Secure heavy sheet goods or similar protective materials in place, in areas subject to foot traffic.
   2. Lay planking or similar rigid materials in place in areas subject to movement of heavy objects and where storage of products will occur.

G. Waterproofed and Roofed Surfaces:
   1. Restrict use of surfaces for traffic of any kind, and for storage of products.
   2. When an activity is mandatory, obtain recommendations for protection of surfaces from manufacturer. Install protection and remove on completion of activity. Restrict use of adjacent unprotected areas.

H. Lawns and Landscaping: Restrict traffic of any kind across planted lawn and landscaped areas.

I. Adjacent Facilities: Care shall be exercised to prevent damage to adjacent facilities including walks, curbs, and gutters. Planking shall be placed where equipment will pass over such obstructions, and facilities damaged by construction operations shall be removed and replaced at Contractor's expense.

J. Overloading: Contractor shall be responsible for overloading any part or parts of structures beyond the calculated capacities of the design. Placing materials, equipment, tools, machinery or any other item shall be done with care to avoid overloading. No loads shall be placed on floors or roofs before they have attained their permanent and safe strength.
K. Damaged Work: All damaged work shall be replaced, repaired and restored to its original condition without change to the Contract Sum. Repair or replace all damaged work promptly as directed by University's Representative.

L. Damaged Utilities: Where existing utilities are damaged or disrupted on account of any act, omission, neglect or misconduct of the Contractor in the manner or method of executing the Work, or due to non-execution of work, such damage shall be immediately repaired to maintain operation regardless of the time of occurrence.

M. Temporary Construction: Provide temporary construction necessary for protection of building and its parts. Close in buildings as soon as possible to protect from weather and vandalism. Protect existing buildings and controlled temperature areas from damage.

N. Doors and Casework: Protect doors, millwork and mill counters and cases and hardware from damage, including abrading and scratching of finishes. Protect doors and frames and hardware from mechanical damage and damage to anodic coatings.

O. Protective Coatings: Remove protective coatings, etc., as required to leave work in condition for painting and finishing, final cleaning, etc.

P. Exterior Work: Protect all exterior work, including existing asphalt paving and landscaping and buildings.

END OF SECTION 01 76 00
SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Project Closeout Procedures

B. Contract Closeout Procedures

1.2 RELATED SECTIONS

A. Section 01 31 00 – COORDINATION

B. Section 01 33 23 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES: Administrative general requirements for submittals.

C. Section 01 56 00 – TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS: Removal of Controls.

D. Section 01 74 00 – CLEANING: Final Cleaning.

E. Section 01 78 00 – CLOSEOUT SUBMITTALS

1.3 FINAL COMPLETION ACTIONS

A. On Application for Payment that coincides with date Substantial Completion is claimed, show 100% completion for portion of Work claimed substantially complete.

B. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.

C. Change building locks from construction to permanent keying, as directed by University's Representative.

D. Complete start-up testing of systems, and instruction of University personnel. Remove temporary facilities from site, along with construction tools, mock-ups, and similar elements.

1.4 SUBSTANTIAL COMPLETION REVIEW

A. Preliminary Punch List Review: At Contractor's request, University's Representative will attend preliminary contract closeout review, not later than fourteen (14) calendar days prior to anticipated Substantial Completion review date.

1. Contractor shall provide at preliminary review a typewritten list (Preliminary Punch List) of items to be completed and corrected.

2. List shall identify items by location (e.g., room number and name) and consecutive number (e.g., 307-5 might identify item 5 in room 307, Roof-4 would identify item 4 on Roof).

3. Segregate architectural, plumbing, HVAC and electrical Work on separate lists.
4. University's Representative and Contractor shall conduct a brief walk-through of Project to review scope and adequacy of list.

B. Contractor's Certification: When determined by Contractor that Work is substantially complete, Contractor shall notify University's Consultant and University's Representative.

1. Submit to University's Representative written certification that:
   a. Contract Documents have been reviewed.
   b. All portions of Work have been carefully inspected.
   c. Work is complete in accordance with Contract Documents.
   d. Equipment and systems have been tested, adjusted and balanced and are fully operational.
   e. Operation of systems has been demonstrated to University personnel.
   f. Work is ready for University's Consultant's Substantial Completion review.

2. Provide minimum seven (7) working days notice to University's Representative prior to desired date for Punch List review.

C. Punch List Review: University's Representative and University's Consultants as may be required, will attend a Contract closeout review and conduct a walk-through of Project to review Contractor's list of items to be completed and corrected (Punch List). Contractor and University's Consultant shall note deficiencies, if any.

1. Contractor shall prepare list and record additional items as University's Representative may determine require completion and correction from walk-through.
   a. If deficiencies are noted University's Representative and University's Consultant shall promptly notify Contractor in writing, listing observed deficiencies.
   b. If no deficiencies are noted, or when noted deficiencies are removed from the Punch List, University's Representative shall promptly notify Contractor.

2. Contractor shall re-type and distribute list with University's Representative and University's Consultant's additions.

3. Contractor shall remedy deficiencies.

4. Costs of additional visits to site by University's Consultants to review completion and correction of Work shall be deducted from the Contract Sum.

D. Uncorrected Work: Refer to requirements specified in SECTION 01 45 00 – QUALITY CONTROL regarding Contract adjustments for non-conforming work.
E. Cleaning and Clearing: Prior to Substantial Completion review, execute cleaning and clearing site of temporary facilities and controls, as specified in SECTION 01 56 00 – TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS.

F. Testing and Inspection: Prior to Substantial Completion review, complete all tests and inspections and submit applicable reports and approvals.

1. Complete materials tests and inspections.
2. Complete testing, inspection, balancing, sterilization and cleaning of plumbing and HVAC systems.
3. Complete testing and inspection of electrical system.
4. Complete operational tests of equipment.

G. Consultant’s Certification: University’s Consultant will complete and issue notice of Substantial Completion on American Institute of Architect’s Form G704 – CERTIFICATE OF SUBSTANTIAL COMPLETION.

1. Certificate will be completed when University’s Consultant determines that list of items to be completed and corrected (Punch List) are sufficiently complete for University to occupy Project for the use intended.
2. University’s Consultant will forward copies of completion certification to University and Contractor.
3. IF OSHPD PROJECT: Submit two (2) originals of Contractor’s Final OSHPD Verified Reports to University’s Representative certifying completion of the Work in conformance with the Contract Documents. Report forms will be supplied by University’s Representative.

H. Acceptance of the Work shall not relieve Contractor of any responsibility for defects that develop during the guarantee period and are caused by Contractor’s failure to perform work in accordance with requirements of Contract Documents.

1.5 FINAL COMPLETION SUBMITTALS

A. Evidence of Compliance with Requirements of Governing Authorities:

2. Compliance Notification: In conformance with State of California Energy Conservation Standards, Contractor shall, at time of request for final inspection, issue to University’s Representative notarized certificate stating completed work appears, in every material respect, to be in compliance with approved Contract Documents. Provide only if specifically required.

B. Final Specifications Submittals: Submit to University’s Consultant all documents and products required by Specifications to be submitted, including the Following:

1. Project Record Drawings: Submit under provision of SECTION 01 78 00 – CLOSEOUT SUBMITTALS.
CLOSEOUT PROCEDURES

2. Operation and Maintenance Data: Submit under provision of SECTION 01 78 00 – CLOSEOUT SUBMITTALS.

3. Guarantees, Warranties, Bonds, Service and Maintenance Contracts: Submit under provision of SECTION 01 78 00 – CLOSEOUT SUBMITTALS.

4. Spare Parts and Maintenance Materials: Submit under provision of SECTION 01 78 00 – CLOSEOUT SUBMITTALS.

5. Keys and Keying Schedule: At completion of Project, all keys shall be returned to University's Representative. Failure to return a key will obligate Contractor for all costs of re-keying facility.

C. Certificates of Compliance and test Report Submittals: Submit to University's Representative certificates and reports as specified and required, including the following:

1. Sterilization of water system
2. Sanitary sewer system tests
3. Gas system tests
4. Lighting, power and signal system tests
5. HVAC equipment and air balance tests

D. Lien and Bonding Company Releases: Submit to University's Representative, copies of all conditional and unconditional general/subcontractor lien releases showing satisfaction of encumbrances and release of liens of Project by completion and submission of Exhibits of the General Conditions of the Contract, as applicable. Signatures shall be notarized.

E. Subcontractor's List: Submit to University's Representative five (5) copies of updated Subcontractor and Materials Supplier List.

F. Warranty Documents: Prepare and submit to University's Representative all warranties and bonds as specified in SECTION 01 78 00 – CLOSEOUT SUBMITTALS.

1.6 STATEMENT OF ADJUSTMENT OF ACCOUNTS

A. Submit final statement reflecting adjustments to Contract Sum indicating:

1. Original Contract Sum
2. Previous Change Orders
3. Changes under allowances
4. Changes under unit prices
5. Deductions for uncorrected work
6. Penalties
7. Deductions for liquidated damages
8. Deductions for re-inspection fees
9. Other adjustments to Contract Sum
10. Total Contract Sum as adjusted
11. Previous payments
12. Sum remaining due

B. University will issue a final Change Order reflecting approved adjustments to Contract Sum not previously made by Change Order.

1.7 APPLICATION FOR FINAL PAYMENT

A. Final Payment: After completion of all items listed for completion and correction, after submission of all documents and products, and after final cleaning, submit final Application for Payment, identifying total adjusted Contract Sum, previous payments and sum remaining due. Refer to SECTION 01 29 00 – MEASUREMENT AND PAYMENT and the General Conditions of the Contract.

B. Submit Record Documents to University's Representative with final Application for Payment.

1.8 PROJECT AS-BUILT DOCUMENTS

A. Maintain on site, one (1) set of the following as-built documents and record actual construction and all revisions to the Work:

1. Contract Drawings
2. Contract, with Specifications, Addenda, Change Orders, and modifications to the Contract.
3. Approved shop drawings, product data and samples.
4. Store As-built Documents separate from documents used for construction.

B. Drawings: Record information continuously as Work progresses. Do not conceal Work permanently until required information is recorded.

C. Specifications: In PART 2 – PRODUCTS in each Section, legibly mark and record actual Products installed or used, including:

1. Manufacturer, trade name, product model or catalog number and supplier of each product or item of equipment installed.
2. Product substitutions or alterations utilized.
3. Changes made by Addenda, Modification, Change Order, Field Order, and clarifications or interpretations made by Letter of Instruction.

D. As-built Drawings: Keep up to date during entire progress of the Work and make available to University at any time. Recording of the As-built condition shall be carefully and neatly done by a competent drafter, familiar with the trade involved, using methods
acceptable to University's Representative. Legibly and to scale, mark a reproducible set of Contract Drawings to record all changes in size, location, and other features of installation in the actual construction, including:

1. Measured depths of foundations and footings encountered, measured in relationship to finish First Floor datum.

2. Measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent ground improvements.
   a. Locations of work buried under or outside building footprint, such as plumbing and electrical lines and conduits.
   b. Record all locations of underground work, points of connection, valve locations, manholes, catch basins, capped stub-outs, invert elevations, etc.

3. Field changes of dimension and detail.
   a. Locations of all significant work concealed inside building, the locations of which are changed by Contractor from those shown on Contract Drawings.
   b. Locations of all items, not necessarily concealed, which vary from locations shown on the Contract Drawings.
   c. Record sufficient information so that concealed work may be located with reasonable ease and accuracy.

4. Actual numbering of each electrical circuit.

5. Details not on original Contract Drawings.

6. Additional drawings as required to properly describe changes.

7. Reproducible set of Contract Drawings will be provided to Contractor by University's Representative.

E. Shop Drawings: Provide reproducible Record copy, made from final Shop Drawings, updated to show actual conditions for work specified in individual Sections.

F. Large Scale Drawings: Divisions 21 through 28 of the Contract Specifications require preparation of large-scale, detailed layout drawings for the work of those Divisions. These layout drawings are not shop drawings as defined by the General Conditions of the Contract but together with Shop Drawings or layout drawings of all other affected sections, are used to check, coordinate and integrate the Work of the Various Sections. Maintain and submit these layout drawings as part of the Project Record Drawings.

G. Acceptance: All Record Documents are subject to review and acceptance by University.
PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 77 00
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment Data
B. Operation and Maintenance Instructions
C. Instruction of UCDMC personnel
D. Schedule of Submittals
E. Spare Parts and Maintenance Materials
F. Guarantees, Warranties, Bonds, Service and Maintenance Contracts
G. Project As-built Documents

1.2 RELATED SECTIONS

A. Section 01 31 00 – COORDINATION
B. Section 01 33 23 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
   1. Administrative general requirements for submittals.
C. Section 01 45 00 – QUALITY CONTROL: Manufacturer's tests and inspections as a condition of warranty.
D. Section 01 60 00 – PRODUCT REQUIREMENTS
E. Section 01 77 00 – CLOSEOUT PROCEDURES

1.3 EQUIPMENT DATA AND OPERATION AND MAINTENANCE INSTRUCTIONS

A. Preparation of data shall be done by persons:
   1. Trained and experienced in maintenance and operation of described products.
   2. Familiar with requirements of this Section.
   3. Skilled in technical writing to extent required for communication of essential data.
   4. Skilled as drafters competent to prepare required drawings.

1. Binders: Commercial quality, 8-½” x 11”, three-ring binders with hardback, cleanable, plastic covers; 1” minimum, 1-½” maximum ring size. Provide separate binders, submitted separately for each discipline, i.e. Site Work, Doors and Windows, Conveying Systems, Mechanical, Plumbing, Electrical, etc. Correlate data into related consistent groupings. Provide two (2) copies of data in Adobe PDF format on CD as well.

2. Cover: Identify each binder with typed or printed title “EQUIPMENT DATA AND OPERATION AND MAINTENANCE INSTRUCTIONS”.
   a. List title of Project and AC # and particular building as applicable.
   b. Identify contents.

3. Organization: Arrange content by systems under Section numbers and sequence in accordance with the Project Specifications Table of Contents. Provide tabbed flyleaf for each separate product and system with typed description of product and major component parts of equipment.

4. Text: Manufacturer's printed data or typewritten data on 20 pound paper.

5. Drawings: Provide with reinforced punched binder tabs. Bind in with text; fold larger drawings to size of text page. Do not hole punch drawings. Insert drawings in clear plastic holder.

C. Table of Contents, Each Volume: Provide title of Project, AC #, with names, addresses, and telephone numbers of University's Representative, as applicable, and Contractor, including name of contact person. Provide schedule of products and systems, indexed to content of the volume.

1. For each Product or System: List names addresses and telephone numbers of subcontractor, original supplier and manufacturer, as applicable, including name of contact person. Include name and address of local source of supplies and replacement parts.

2. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete information not applicable.

3. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

4. Additional Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in SECTION 01 45 00 – QUALITY CONTROL.

5. Warranties and Bonds: Bind in copy of each.
D. Manual for Materials and Finishes:

1. Building Products, applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Provide information for re-ordering custom manufactured Products.

2. Instruction for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.


5. Table of Contents: Provide a listing in Table of Contents for design data, with tabbed binder divider page and space for insertion of data.

E. Manual For Equipment And Systems

1. Record Instructions: Forward to University’s Representative, upon completion of work, and before work will be considered for acceptance, complete bound sets of instructions of entire plant and component parts, including manufacturer’s certificates, warranty slips, parts lists, descriptive brochures, and maintenance and operating instructions, in quantities set forth in various Divisions. Print information on heavy white paper, tab properly and identify for each reference. Submit drafts for review before preparing final sets, six (6) copies required.

2. O & M Instructions: Provide and install, where directed, printed sheet under clear plastic cover, giving concise operating and maintenance instruction for equipment.

3. Each Item of Equipment and Each System: Inclusive description of unit or system, Model Number, Serial Number, and component parts. Identify function, normal characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts. Best to include all information provided in final approved equipment submittal. Design drawing data may not reflect what was actually provided.

4. Panelboard Circuit Directories: Provide electrical service characteristics, controls and communications.

5. Wiring Diagrams: Include color-coded wiring diagrams as installed.

6. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and any special operating instructions.

7. Maintenance Requirements: Include routine procedures and guide for troubleshooting; disassembly, repair, and re-assembly instructions; and alignment, adjusting, balancing, and checking instructions. Provide servicing and lubrication schedules, and list of lubricants required.
8. Instructions: Include manufacturer's printed operation and maintenance instructions. Include sequence of operation by controls manufacturer.

9. Parts Data: Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

10. Control Data: Provide as installed control diagrams by controls manufacturer.

11. Piping Data: Provide Contractor's coordination drawings, with color piping diagrams as installed. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

12. Design Data: Provide a listing in table of Contents for design data, with tabbed binder divider page and space for insertion of data.

13. Reports: Include test and balancing reports as specified in SECTION 01 86 00 – PLUMBING/HVAC TESTING PROCEDURES.


F. Instruction of University's Personnel: Instruct University designated personnel to their full and complete understanding, procedures necessary to operate and maintain equipment and systems on continuing basis. Provide training of staff.

1. Schedule: Before final inspection, instruct University designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times. For equipment requiring seasonal operation, perform instructions for other seasons within six (6) months of completion.

2. Basis of Information: Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

3. Instructional Material: Prepare and insert additional data in the manual when need for such data becomes apparent during instruction.

G. Equipment Data and Operation and Maintenance Instructions Submittals:

1. Submittals: Comply with administrative requirements specified in SECTION 01 33 23 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

2. Preliminary Draft Submittal: Submit two (2) copies of preliminary draft or proposed formats and outlines of contents no later than ten (10) days of equipment submittals approval. University's Representative will review draft and return one (1) copy with comments.

3. Advance Submittals: For equipment, or component parts of equipment to be put into service during construction and operated by University, submit documents within ten (10) calendar days after equipment approval.

4. Final Submittal: After completion of instruction of University operation and maintenance personnel and final inspection, revise content of documents to include additional information deemed necessary from instruction experience of University's Personnel.
University's personnel and any changes made during construction. Submit three (3) copies of completed volumes in final form a minimum of ten (10) calendar days after final inspection.

1.4 SPARE PARTS AND MAINTENANCE MATERIALS

A. Products Required: Where called for in Contract Specifications, deliver to University's Representative, materials, etc., for use in maintenance work. Provide list of materials delivered to University's Representative, indicating date and acceptance by University's Representative.

1. Provide quantities of products, spare parts, maintenance tools, and maintenance materials specified in individual Sections to be provided to University's Representative, in addition to that required for completion of the Work.

2. Products supplied shall be identical to those installed in the Work. Include quantities in original purchase from supplier to avoid variations in manufacture.

B. Storage, maintenance: Store products with products to be installed in the Work, as specified in SECTION 01 60 00 – PRODUCT REQUIREMENTS: Product Storage and Protection.

C. Delivery to site: Prior to final payment, deliver and unload spare products to project site. Coordinate with University's Representative and obtain receipt. University will handle and store products.

1.5 WARRANTIES AND GUARANTEES

A. Warranties and Guarantees, general: Guarantees from subcontractors shall not limit Contractor's warranties and guarantees. Whenever possible, Contractor shall cause warranties of subcontractors to be made directly to University. If such warranties are made to Contractor, Contractor shall assign such warranties to University prior to final payment. When equipment and products, or components thereof, bear a manufacturer's warranty or guarantee that extends the time period of Contractor's warranty or guarantee, so state in the warranty or guarantee.

1. Standard Product Warranties: Preprinted written warranties published by individual manufacturers for particular products and specifically endorsed by manufacturer to University.

2. Special Warranties: Written warranties required by or incorporated in Contract Documents, to extend time limits provided by standard warranties or to provide greater rights for University.

3. Provisions for Special Warranties: Refer to General Conditions of the Contract for terms of Contractor's special warranty of workmanship and materials.

4. Specific Warranty Requirements: requirements are included in the individual Sections of Division 02 through 49 of the Contract Specifications, including content and limitations.

5. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of warranty on work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors requirement to countersign special warranties with Contractor.
6. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

7. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to original warranty with an equitable adjustment for depreciation.

8. Replacement Cost: On determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. Contractor shall be responsible for cost of replacing or rebuilding defective work regardless of whether University has benefited from use of the work through part of its useful service life.

9. UCDMC Recourse: Written warranties made to University are in addition to implied warranties, and shall not limit duties, obligations, right and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which University can enforce such other duties, obligations, rights, or remedies.

10. Rejection of Warranties: University reserves right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

11. University reserves right to refuse to accept work where a special warranty, or similar commitment is required, until evidence is presented that entities required to countersign commitments are willing to do so.

12. When designated portion of Work is completed and occupied or used by separate agreement with Contractor during the construction period, submit properly executed warranties to University's Representative within fourteen (14) calendar days of completion of that designated portion of the Work.

13. Submit written guarantees, in the form contained at end of this Section.

B. Form of Warranty or Guarantee: All written warranties and guarantees, excepting manufacturers' standard printed warranties and guarantees, shall be submitted on Contractor's, subcontractor's, material supplier's, or manufacturer's own letterhead, addressed to University. Warranties and guarantees shall be submitted in duplicate, and complying with the form letter following. Warranty and guarantee letters shall be signed by all responsible parties and by Contractor in every case, with modifications only as approved by University to suit the conditions pertaining to the warranty or guarantee.

C. Submission requirements:

1. Contractor shall collect and assemble required warranties, guarantees, bonds, and service and maintenance contracts. Provide two (2) original signed copies of each.

2. Table of Contents: Neatly typed and in orderly sequence, provide complete information for each items as follows:

   a. Product or Work item.
b. Product or work suppliers firm name, address, telephone number and name of principal.

c. Scope of guarantee, bond, service or maintenance agreement.

d. Date of beginning of guarantee, bond, service or maintenance contract.

e. Duration of guarantee, bond, service or maintenance contract.

f. Contractor's name, address, telephone number and name of principal.

g. Provide information for University personnel:
   1) Proper procedure in case of failure.
   2) Circumstances that might affect validity of guarantee or bond.

D. Form of Submittals: Prepare in duplicate packets.

1. Size: 8-½” x 11” sheets punched for 3-ring binder. Fold larger sheets to fit into binders.

2. Identify each packet on cover with typed or printed title, "GUARANTEE AND BONDS", and the following:
   a. Title of Project.
   b. Project A/C #.
   c. Name of Contractor.


E. Time of Submittals: Submit within ten (10) calendar days of Substantial Completion, prior to request for final payment. When work activity is delayed materially beyond date of Substantial Completion, provide updated submittal within ten (10) calendar days after Final Completion, listing date of Final Completion as the start of the Guarantee period.

F. Submittals Required: Submit guarantees, bonds, service or maintenance contracts specified in individual Sections of the Specifications.

1. Contractor shall collect and assemble all written warranties and guarantees into a binder.

2. Submit all required Warranties and Guarantees on letterhead of Contractor.

1.6 PROJECT RECORD DOCUMENTS

A. Maintenance of Record Documents and Samples:

1. Provide complete set of Record Drawings and Specifications, showing every change from original Contract set, including all Addenda, Change Order, job decisions, etc. Prints for this purpose may be obtained from University's Representative.
2. When work is complete and prior to final payment, submit one (1) complete set of all record documents, marked to show any deviation from the original Contract set. These documents are to be an accurate description of all work as-built.

3. Prior to Application for final payment, a set of drawings shall be obtained from University's Representative and all changes, as noted on the Record Drawings shall be incorporated thereon. The set of drawings, together with one (1) copy therefrom, shall be delivered to University's Representative.

4. Label and file record Documents and samples in accordance with Section number listings in the Project Specifications Table of Contents. Label each document "PROJECT AS-BUILT" in neat, large, printed letters. Each document and sample shall include the University's Project title and A/C number for reference purposes.

5. Maintain Record Documents in a clean dry and legible condition. Do not use Record Documents for construction purposes. Keep record Documents and samples available for inspection by University.

6. Record Schedule: Contractor shall provide Record Schedule of construction activities. Schedule shall be in same format as specified in SECTION 01 32 00 – CONTRACT SCHEDULES.

B. Submittals: At Contract closeout, deliver Record Documents and samples as required by SECTION 01 77 00 – CLOSEOUT PROCEDURES.

1. Transmit with cover letter in duplicate, listing:
   a. Date.
   b. Project title and A/C number.
   c. Contractor's name, address and telephone number.
   d. Number and title of each Record Document.
   e. Signature of Contractor or authorized representative.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 78 00
GUARANTEE

Project Name:

Project Location:

Project Number: DATE:

GUARANTEE FOR (Specification SECTION and Contract No.) (the "Contract"),

between The Regents of the University of California ("University") and

(Name of Contractor or Subcontractor)

hereby guarantees to University that the portion of the Work described as follows:

which it has provided for the above referenced Project, is of good quality; free from defects; free from any liens, claims, and security interests; and has been completed in accordance with Specification SECTION ____________________________________ and the other requirements of the Contract.

The undersigned further agrees that, if at any time within ________ months after the date of the guarantee the undersigned receives notice from University that the aforesaid portion of the Work is unsatisfactory, faulty, deficient, incomplete, or not in conformance with the requirements of the Contract, the undersigned will, within 10 days after receipt of such notice, correct, repair, or replace such portion of the Work, together with any other parts of the Work and any other property which is damaged or destroyed as a result of such defective portion of the Work or the correction, repair, or replacement thereof; and that it shall diligently and continuously prosecute such correction, repair, or replacement to completion.

In the event the undersigned fails to commence such correction, repair, or replacement within 10 days after such notice, or to diligently and continuously prosecute the same to completion, the undersigned, collectively and separately, do hereby authorize University to undertake such correction, repair, or replacement at the expense of the undersigned; and Contractor will pay to University promptly upon demand all costs and expenses incurred by University in connection therewith.

SUBCONTRACTOR

Signed: ___________________________________________________________________ Title: ____________________________

Typed Name: ___________________________________________________________________

Name of Firm: ___________________________________________________________________

Contractor License Classification & Number: ____________________________

Address: ___________________________________________________________________

Telephone Number: __________________________________

CONTRACTOR

Signed: ___________________________________________________________________ Title: ____________________________

Typed Name: ___________________________________________________________________

Name of Firm: ___________________________________________________________________

Contractor License Classification & Number: ____________________________

Address: __________________________________________________________________

Telephone Number: __________________________________
REPORT OF WORK REQUIRED BY WARRANTY

To: (PM’s NAME), University Representative
From:

On the date noted, the University identified the following work required under warranty:

Prepared by: ___________________________ Signature ___________________________ Date ___________________________

In accordance with the terms and conditions of the Contract, the Contractor has agreed that, if at any time within ______ months after the date of the guarantee the Contractor receives notice from University that the aforesaid portion of the Work is unsatisfactory, faulty, deficient, incomplete, or not in conformance with the requirements of the Contract, the Contractor will, within 10 days after receipt of such notice, correct, repair, or replace such portion of the Work, together with any other parts of the Work and any other property which is damaged or destroyed as a result of such defective portion of the Work or the correction, repair, or replacement thereof; and that it shall diligently and continuously prosecute such correction, repair, or replacement to completion.

Prompt notification to be provided by the University Representative to the appropriate Contractor.
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Procedures for Demonstration of Equipment Operation and Instruction of University Personnel.

1.2 RELATED SECTIONS

A. Section 01 78 00 – CLOSEOUT SUBMITTALS

B. Section 01 86 00 – PLUMBING/HVAC TESTING PROCEDURES

1.3 SUBMITTALS

A. Submit preliminary schedule for University Representative approval, listing times and dates for demonstration of each item of equipment and each system, in writing, minimum of fourteen (14) calendar day prior to activities.

B. Submit reports within (1) week after completion of demonstrations, that demonstrations and instructions have been satisfactorily completed. Give time and date of each demonstration, and hours devoted to demonstration with a list of persons present.

1.4 QUALITY ASSURANCE

A. Equipment installed under Contract shall operate quietly and free of vibration. Adjust, repair, balance properly, or replace equipment producing objectionable noise or vibration in occupied areas of building. Provide additional brackets, bracing, etc., to prevent such noise or vibration. Systems shall operate without humming, surging or rapid cycling.

B. University will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon time.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify equipment has been inspected and put into operation.

B. Have copies of completed operation and maintenance manual at hand for use in demonstration instructions.

3.2 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of equipment and systems to University two (2) weeks prior to date of final inspection. For equipment requiring seasonal operation, perform instructions for other seasons within six (6) months of completion.
B. Use operation and maintenance manuals as basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled times, at equipment location.

D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

END OF SECTION 01 79 00
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Procedures for Adjusting and Balancing Systems.

1.2 RELATED SECTIONS

A. Section 01 45 00 – QUALITY CONTROL: Testing organization services.

B. Section 01 75 00 – STARTING, AND ADJUSTING SYSTEMS: Starting and adjusting equipment prior to commissioning.

C. Divisions 22-23 Sections, as applicable.

D. General Conditions of the Contract: Inspections, tests and approvals required by governing authorities.

1.3 SUBMITTAL REQUIREMENTS

A. Service Provider: Prior to start of work, submit name or organization proposed to perform services. Designate managerial responsibilities for coordination of all testing activities.

B. Qualifications: Submit documentation to confirm organization qualifications.

C. Report Forms: Submit three (3) preliminary specimen copies of each report form proposed for use.

D. Final Report Submission: Fourteen (14) calendar days prior to completion submit three (3) copies of final reports. Submit reports of testing that are postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor’s control, promptly after execution of those services.

1.4 GENERAL PROCEDURES

A. Procedural Compliance: Comply with procedural standards of certifying association under whose standard services will be performed.

B. Notification: Notify University’s Representative, in writing, minimum of fourteen (14) calendar days prior to beginning service operation.

1. Record Keeping: Accurately record date for each step.

2. Report to University’s Representative any defects or deficiencies noted during performances of services.

1.5 FINAL REPORTS

A. Organization having managerial responsibility shall make reports.
B. Each Form shall bear signature of recorder, and that of supervisor of reporting organization.

C. Identify each instrument used and latest date of calibration of each.

1.6 CONTRACTOR RESPONSIBILITIES

A. Prepare each system for testing.

B. Coordinate with testing organization; provide access to equipment and systems. Operate systems at designated times, and under conditions required for proper testing.

C. Notify testing organization fourteen (14) calendar days prior to time system will be ready for testing.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide instruments required for testing operations. Make instruments available to University to facilitate spot checks during testing. Retain possession of instruments and remove at completion of services.

B. Verify installation of system to be tested is complete and in continuous operation.

C. Verify ambient conditions and related facilities are in full operation.

3.2 SCHEDULE OF SYSTEMS REQUIRING TESTING SERVICES

A. Test piping at completion of roughing in, in accordance with the following schedule and show no loss in pressure or visible leaks after minimum duration under water pressure as set forth:

<table>
<thead>
<tr>
<th>TEST SCHEDULE SYSTEM TESTED</th>
<th>TEST PRESSURE PSIG</th>
<th>DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Soil, Waste Drain and Vent Piping, and All Storm Drains</td>
<td>Test with water to top of highest vent, minimum of 10’.</td>
<td>2 Hours</td>
</tr>
<tr>
<td>All Underground Soil, Waste Drain, Vent Piping and Storm Drain Piping</td>
<td>5 psig - “Air”</td>
<td>15 Minutes</td>
</tr>
<tr>
<td>Heating and Chilled Water Distribution System Connections</td>
<td>225 psig</td>
<td>4 Hours</td>
</tr>
<tr>
<td>Domestic Hot &amp; Cold Water Piping</td>
<td>150 psig at rough in</td>
<td>2 Hours</td>
</tr>
<tr>
<td>Low Pressure Steam And Condensate</td>
<td>150 psig</td>
<td>2 Hours</td>
</tr>
<tr>
<td>High Pressure Steam</td>
<td>50% above Design Operation Pressure</td>
<td>4 Hours</td>
</tr>
<tr>
<td>Fire Sprinkler Piping Water</td>
<td>200 psig</td>
<td>2 Hours</td>
</tr>
<tr>
<td>Ductwork</td>
<td>See Division 23 for testing requirements</td>
<td></td>
</tr>
</tbody>
</table>

*The air test shall be made by attaching an air compressor testing apparatus to any suitable opening, and after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gage pressure.*

B. Testing equipment, materials, and labor shall be furnished by Contractor.
C. Repair piping systems sections which fail required piping test, by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

END OF SECTION 01 86 00
SECTION 02 82 00
ASBESTOS ABATEMENT AND IN-PLACE MANAGEMENT

PART I - GENERAL

1.01 DESCRIPTION

A. The safe abatement and in-place management of asbestos containing materials (ACM) and presumed asbestos containing materials (PACM) for M030667, Hospital Seismic Upgrade – Decommission North/South Wing – increment 4, is the primary purpose of this specification. The contract provisions are designed to protect University community members from exposure as a result of work being performed by the Contractor.

1.02 SCOPE OF WORK

A. Work Included – General

1. The Contractor shall furnish all labor, materials, equipment, services, testing, employee training, fit tests, medical exams, transportation, insurance, and daily expense to meet the requirements of this specification.

2. The Contractor shall obtain all required permits, licenses, registrations, and notifications, and regulatory approvals required by law and UCDMC policy.

3. All asbestos abatement activities associated with this contract shall be performed between the hours of 7:00 AM to 5:00 PM unless coordinated with the University’s Representative.

4. The Contractor shall guard against unnecessary disturbances or damage to sensitive finishes on buildings, building systems, and equipment.

5. Any job with more than one class designation (see T8 CCR 1529) shall be performed at the higher standard. For example, a contract let for class II and class III work will be performed at the class II level.

B. Work Included – Specific

1. This project consists of decommission of the north/south wing including severing all remaining utilities except as required by the code and providing barriers to restrict all access into the north/south wing.

2. The scope of work will include rerouting remaining plumbing, mechanical and electrical systems to isolate the north/south tower infrastructure from the east tower, construction of all physical barriers to bar all physical access to the north/south tower, and to make ready the north/south structure for demolition.

3. The Contractor is responsible for identifying the exact locations and number of work areas by referring to University supplied project drawings and by working with the University’s Representative.

4. The East Wing and North/South Wing have been tested for asbestos containing materials by various independent asbestos consultants. Asbestos materials have been identified in the project area and will be impacted by the planned project. See Section 1.03 Site Characterization and the table identifying the different
asbestos materials present in the project area. It is the responsibility of the contractor to know which materials have been identified to contain asbestos and which might be impacted by the scope of work.

5. Asbestos Abatement Overview – This project will include removal of asbestos containing materials in locations where work is performed. In many locations, the asbestos will be required to be removed (abated) from the project work area by a licensed asbestos contractor. Subsequent work in these abated locations by trades will be considered “Clean Work Areas” with regards to asbestos, if the asbestos would be removed followed by clearance air sampling performed to demonstrate subsequent work will not involve asbestos. In these Clean Work Areas, work trades will not be required to wear respirators, or coveralls for asbestos, since there would be no asbestos related work. If the asbestos materials are removed under contaminated conditions and the work space does not have clearance air sampling following abatement, the work space shall be deemed a “Dirty Work Area” or “Hot Work Area” related to asbestos.

6. In the North/South Wing and the East Wing, there is asbestos containing fireproofing present on the underside of the roof deck with considerable amount of fireproofing debris on top of the plaster ceiling system and within the interstitial cavities between all plaster walls. Due to the asbestos contamination assumed to be present on top of plaster ceilings and assumed to be present within the open top plaster wall cavities, all wall and ceiling materials within the North/South Wing and the East Wing are considered as asbestos contaminated materials. In addition, all ducts, insulation, electrical wiring, piping, conduit, electrical wiring, etc., located in the attic space and wall cavities are considered contaminated with asbestos.

7. This project will require a licensed asbestos contractor registered with DOSH to perform removal of all selected asbestos containing materials and asbestos contaminated materials within work environments in accordance with Title 8 1529 Asbestos in Construction in order to accomplish the tasks.

5. It is anticipated work will be required in asbestos contaminated spaces by other non-asbestos abatement trade workers, including but not limited to, electricians, plumbers, welders, carpenters and other trades. This will require trades that are trained in asbestos and respiratory protection to work in asbestos contaminated work environments to perform this work. This work is deemed “Hot Work” with regards to working in an asbestos contaminated work space. All trade workers working in asbestos contaminated work areas shall follow good access, egress and decontamination procedures of personnel and tools brought into the work space. In Hot Work areas with asbestos, the contractor shall utilize an asbestos licensed contractor to assist in providing controls for the containment, signage, decontamination procedures, and housekeeping (cleanliness) etc. The asbestos contractor will be required to clean the work space completely after all trade work is performed daily in the Hot Work. All Hot Work with regards to asbestos shall be performed within negative pressure work enclosures and containments which are designed and operated identical for Class I asbestos related work. The engineering controls are the same as those created for a Clean Work area, with the exception that large scale asbestos abatement will not take place. Some spot asbestos abatement is anticipated to be required by the asbestos contractor in a
Hot Work containment, with the majority of asbestos containing materials left in place.

6. In-Place Management of Asbestos - Asbestos materials will be left in place in other areas of the building on this project that will include the fireproofing, floor tiles and mastic, wall plaster systems that are known to have asbestos debris within the cavities, many plaster ceilings with asbestos containing fireproofing debris throughout the attic spaces that will not be cleaned. Since the attic space above the ceiling system of the North/South Wing and the East Wing are considered asbestos contaminated, if access is required to accomplish the scope of work, asbestos training, worker protection, air sampling, decontamination, engineering controls, and other control measures apply for all contractor employees who are required to enter the attic space or who work in areas with asbestos containing materials.

7. Work practices and procedures for asbestos removal are provided in these specifications.

8. The asbestos contractor will be responsible for soft demolition of items from the work area to minimize potential disturbance to asbestos materials.

1.03 SITE CHARACTERIZATION

A. An asbestos inspection has been conducted by the University or the University's Representative's Asbestos Consultant who is a California Certified Asbestos Consultant. Materials found or presumed to contain asbestos at this job site are listed in the table below. The table below does not suggest all of the materials are to be removed. It is provided to inform the contractor on all asbestos containing materials that have been identified in the project area that the contractor will be working near and around during execution of the project. The project specifications and drawings will dictate which materials and locations are to be removed or replaced or impacted.

<table>
<thead>
<tr>
<th>Building Description</th>
<th>System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fireproofing</td>
<td>RACM</td>
</tr>
<tr>
<td>Pipe Insulation</td>
<td>RACM</td>
</tr>
<tr>
<td>Drywall and Joint Compound, Texture and Skim Coats</td>
<td>RACM</td>
</tr>
<tr>
<td>Wall Plaster</td>
<td>RACM</td>
</tr>
<tr>
<td>Ceiling Plaster</td>
<td>RACM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>NESHAP Class</th>
<th>Cal/OSHA Class</th>
<th>% of Asbestos</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fireproofing</td>
<td>RACM</td>
<td>I</td>
<td>10</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Pipe Insulation</td>
<td>RACM</td>
<td>I</td>
<td>20</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Drywall and Joint Compound, Texture and Skim Coats</td>
<td>RACM</td>
<td>I</td>
<td>Assumed &gt; 1%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Wall Plaster</td>
<td>RACM</td>
<td>I</td>
<td>Assumed &gt; 1%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Ceiling Plaster</td>
<td>RACM</td>
<td>I</td>
<td>Assumed &gt; 1%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Duct Insulation in attic and chases contaminated</td>
<td>RACM</td>
<td>I</td>
<td>Assumed &gt; 1%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Exterior Stucco Wall Finish (East Wing Only)</td>
<td>RACM</td>
<td>I</td>
<td>Assumed &gt; 1%</td>
<td>Exterior Finish of East Wing</td>
</tr>
<tr>
<td>Attic Space and Wall Cavities</td>
<td>RACM</td>
<td>I</td>
<td>Assumed &gt; 1%</td>
<td>Throughout Building</td>
</tr>
<tr>
<td>Electrical Wiring in wall cavities and attic spaces contaminated</td>
<td>Cat II</td>
<td>II</td>
<td>Assumed &gt; 1%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Bare Pipes, Conduit, Ducts in attic and wall spaces contaminated</td>
<td>Cat II</td>
<td>II</td>
<td>Assumed &gt; 1%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>9&quot; or 12&quot; Floor Tiles &amp; Black and Brown Mastics</td>
<td>Cat I – VFT Cat II - Mastic</td>
<td>II</td>
<td>Assumed &gt; 1% for Tiles and Mastic</td>
<td>Throughout all floors. See color plates in 2018 asbestos inspection</td>
</tr>
<tr>
<td>Resilient Sheet Flooring and Black/Brown Mastic</td>
<td>RACM</td>
<td>I</td>
<td>Assumed &gt; 1%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Transite Pipes</td>
<td>Cat II</td>
<td>II</td>
<td>Assumed &gt; 1%</td>
<td>Assumed Present Underground</td>
</tr>
<tr>
<td>Transite Material Sandwiched between Metal Ventilator Units at Perimeter Walls (East Wing Only)</td>
<td>Cat II</td>
<td>II</td>
<td>Assumed &gt; 1%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Transite Lab Hoods and Tables</td>
<td>Cat II</td>
<td>II</td>
<td>Assumed &gt; 1%</td>
<td>Laboratories in N/S Wing</td>
</tr>
<tr>
<td>Roofing Material and Roof Mastic</td>
<td>Cat I</td>
<td>II</td>
<td>1-15%</td>
<td>See Drawings</td>
</tr>
</tbody>
</table>

1. The asbestos inspection and lead in paint inspection report "East Wing Hazardous Materials Survey Report" prepared by MACTEC Engineering and Consulting, Inc., November 29, 2005 and the MACTEC "North/South Wing Hazardous Materials Survey Report", November 29, 2005 are attached as an Exhibit to 02 82 00. These inspection reports includes an assessment for hazardous materials including asbestos, lead in paint, fluorescent light tubes and
ballasts containing PCB's. Subsequent asbestos and lead in paint inspections have been conducted by Entek Consulting Group, Inc. with reports provided on July 19, 2017, September 15, 2017, and June 1, 2018 (June 13, 2018 Revision) are attached as an Exhibit. The contractor shall refer to all inspection reports for locations were asbestos has been identified in the East Wing and North/South Wing.

2. Where "See Drawings" are noted in the above table or elsewhere in this specification, refer to Exhibits.

B. Non-asbestos containing materials have been identified and sampled for this project. The table below includes a list of materials sampled and found not to contain asbestos. If the Contractor discovers building materials on the project not included in either Table A. (Asbestos Containing List) or Table B. (Non-asbestos Containing List) the Contractor shall bring this to the attention of the Project Manager, which may result in asbestos sampling by the University's Certified Asbestos Consultant.

| Table B. East Wing - Building Materials Sampled and Found Not to Contain Asbestos |
|----------------------------------|----------------------------------|
| Material Description             | Location                         |
| Acoustic Ceiling Panels (2’x2” and 2’x3”)* | Various Locations                |
| Acoustic Ceiling Tiles (12”x12”) with Mastic* | Various Locations                |
| Base Cove Mastic (4” and 6”)      | Various Locations                |
| Window Putty (Glazing)            | Various Locations                |
| Sink Undercoat (Black)            | Various Locations                |
| Plaster Walls* and Plaster Ceilings* | Various Locations                |
| White and Black Caulking Between Exterior Pre-cast Aggregate Concrete Wall Panels | Exterior Walls                  |
| Gray Caulking Between Exterior Pre-cast Smooth Concrete Wall Panels | Exterior Walls                  |
| Terrazzo Flooring                 | Various Locations                |
| Ventilation Duct Seam Tape        | Various Locations                |
| Concrete                          | Various Locations including Floor in Corridor 0115, Floors and Wall in Exterior Light Well at Basement Level Including Patched Areas of Concrete Floor, Floor of Dumbwaiter Penthouse |
| Concrete Wall Pre-cast Panels (Smooth Finish and Aggregate Finish) | Exterior Wall Panels            |
| Various Electrical Wiring on Control Panels in Dumbwaiter Penthouse | See Entek Inspection Report 7-19-17 |
*Although the drywall plaster walls and ceilings do not contain asbestos themselves, the interstitial wall cavities of all plaster and drywall systems and attic spaces and top surfaces of plaster and all ceiling systems are assumed to be contaminated with asbestos containing fireproofing. Any wall or ceiling systems that are removed will be assumed to be contaminated with asbestos.

C. Hazardous materials, other than ACM/PACM that have the potential to be disturbed at this job site are listed in the table below:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>Type of Hazard</th>
<th>Quantity (approx.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorescent Light Bulbs</td>
<td>Mercury</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Light Ballasts</td>
<td>PCB's</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Light Ballasts</td>
<td>Universal Waste</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Mold Contamination</td>
<td>Mold</td>
<td>Undetermined</td>
</tr>
<tr>
<td>Thermostat Switches</td>
<td>Mercury</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Exit Signs</td>
<td>Radioactive Gas Tritium</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Painted Surfaces &amp; Ceramic Products</td>
<td>Lead in Paint and Glaze</td>
<td>See 02 83 00</td>
</tr>
</tbody>
</table>

1. The Contractor shall review non-asbestos hazardous material required protocols with the University’s Representative, EH&S Representative and the University’s Asbestos Consultant. Lead related work will be addressed in Section 02 83 00 specifications, if applicable.

1.04 JOB WALK PROTOCOL

A. No special provisions are required on the job walk to review the asbestos materials within public corridors, staff rooms, and patient rooms, since there are no areas of known asbestos contamination on this project which the contractor will have to access for the job walk, except for the attic space where it is considered contaminated with asbestos.

B. The pre-bid job walk will not include access into the attic space; however, if a bidder desires to include an inspection of contaminated areas cited in 1.02.A or 1.02.B, the contractor is required to wear respirators and protective clothing per CCR, Title 8 1529. Prior to entering contaminated areas, the bidder must show proof of (1) AHERA or asbestos awareness training and (2) a respirator fit test within the past 12 months.

C. For access into attic spaces in project areas identified with known asbestos containing fireproofing materials, a controlled access (mini-enclosure) will be required by Contractors who desire to look or inspect the attic spaces. Access will require a controlled mini-enclosure to minimize potential asbestos contamination into the space below the ceiling system. This will require an ICRA Permit that is approved and provided by Infection Prevention before access to the attic is allowed.
D. Short Duration Access into the Attic Space (30 minutes/day) – Mini-enclosure

1. Entry protocols - Put on respirator, perform negative pressure and positive pressure fit tests. Put on a disposable coverall (over street clothes) and enter the mini-enclosure to view the contaminated space from a ladder.

2. Exit protocol - Take off the disposable coverall and place into the asbestos waste bag located inside of the mini-enclosure. Wet wipe exposed skin with wet wipes and place into waste bag. While still wearing the respirator exit the mini-enclosure. Remove the respirator outside of the mini-enclosure and tape opening to respirator filters. Wet wipe the respirator, hands and face, and place wet wipes into waste bag.

E. Long Duration Access (>30 minutes/day) -

1. Not Available unless by special request.

1.05 ABBREVIATIONS AND DEFINITIONS

A. Abbreviations

1. ACM: Asbestos Containing Material
2. AHERA: Asbestos Hazard Emergency Response Act
3. CARB: California Air Resources Board
4. CSLB: Contractor's State Licensing Board
5. CDPH: California Department of Public Health
6. DOP: Dispersed Oil Particulate
7. DOSH: Division of Occupational Safety and Health (Cal/OSHA)
8. ELAP: Environmental Laboratory Accreditation Program
9. EH&S: UCDMC Department of Environmental Health & Safety
10. NEA: Negative Exposure Assessment
11. NPE: Negative Pressure Enclosure
12. NVLAP: National Voluntary Laboratory Accreditation Program
13. PACM: Presumed Asbestos Containing Material
14. RACM: Regulated Asbestos Containing Material
15. TSI: Thermal System Insulation
16. University or University of California Davis Medical Center (UCDMC), or Owner shall be considered the same entity when used in these specifications.

B. Definitions: The following definitions are provided for additional clarification to the California Code of Regulations (CCR), Title 8, 1529 and the Sacramento Metropolitan Air Quality Management District (SMAQMD) Rule 902.

1. ACM and PACM are defined in 8 CCR 1529; which includes friable and non-friable asbestos. These regulations include the use of worker protection, negative pressure enclosures (NPE), air monitoring, etc.

2. Ambient Air Quality refers to the quality of local air conditions prior to the commencement of asbestos related work.

3. Per T8 CCR 1529, Class I asbestos work involves the removal (abatement) of TSI or Surfacing material when (1) more than one glove bag is used or (2) removal of TSI or Surfacing material consisting of more than one 60" X 60" waste
4. Per T8 CCR 1529, Class II asbestos work involves the removal (abatement) of non-TSI or non-surfacing material if the work is not repair or maintenance as defined by Class III. Examples of Class II work include removal of floor tile, floor mastics, gypsum wallboard with joint compound, roofing and siding shingles, construction mastics, etc.

5. Per T8 CCR 1529, Class III asbestos work involves repair and maintenance of friable ACM/PACM that is either TSI or Surfacing materials, but does not exceed the removal of ACM/PACM that exceeds either one glove bag or one 60" x 60" disposal waste bag.

6. Per T8 CCR 1529, Class IV asbestos work refers to contact but no disturbance of ACM/PACM. Class IV work refers to clean-up operations of Class I, II, or III projects. Class IV work does not refer to incidental contact by maintenance workers (see B CCR 5208 for custodial/maintenance workers guidelines).

7. Negative Pressure Enclosure (NPE) refers to full containment and mini-containments under negative pressure with HEPA filtered exhaust.

1.06 SUBMITTALS

A. The submittals listed in 1.06 B must be completed and accepted by the University's Representative with the concurrence of the EH&S Representative prior to the contractor beginning any work.

B. List of Submittals:

1. References to include three projects of similar scope and size.
2. Notifications to Cal/OSHA and Sacramento Metropolitan AQMD (if applicable).
3. Permits if applicable (federal, state, local, or UCDMC).
5. Copies of all asbestos training and respiratory training for various Trade workers who will be working in the contaminated work spaces. See Section 3.07.
6. Current respiratory fit test records (within past 12 months) for all workers required to wear a respirator.
7. Physician's certificates of medical fitness for respiratory use for all workers wearing a respirator and medical evaluation for asbestos related work (within 12 months) for all asbestos abatement workers.
8. DOSH Registration for asbestos related work.
9. DOP certificates for all HEPA vacuums and negative air machines, which are required to be tested onsite and witnessed by UCDHS EH&S or the University's Asbestos Consultant. Submit after equipment has arrived on campus and has been tested. Provide information of the company providing the DOP challenge testing of the HEPA filter systems showing proficiency in the testing. Include evidence of the training of personnel conducting the challenge testing.
10. List of HEPA vacuums and negative air machines to be used on the project (mfg. model and serial numbers).
11. Safety Data Sheets for all products used at the job site.
12. List all laboratories used by Contractor for air or bulk samples. Provide proof of
current AIHA Proficiency Analytical Testing (PAT) Program with passing scores.

13. California Contractor’s License C22 for asbestos.
14. Waste Disposal Plan including name of disposal site, waste transporter, and waste transporter certification.
15. Substitute Materials Information (for any material not listed in 2.01).
16. General liability insurance certificate with Owner and asbestos consultant named as additional insured.
17. Auto insurance certificate.
18. Workers Compensation Insurance certificate.
19. Written work plan including schedule, emergency plans, route of waste transport from project site to waste bin.
20. Manufacturer’s documentation of 5.0 micron filter that shall be used for filtration of all water from the shower and other asbestos related work.

1.07 CONTRACTOR QUALIFICATIONS

A. The contractor performing asbestos abatement work shall be currently licensed as an Asbestos Contractor (C22) with the California Contractor’s Licensing Board.

B. The contractor performing asbestos abatement work shall be currently registered for asbestos with the California Department of Industrial Relations, Division of Occupational Safety and Health (DOSH).

C. The contractor’s personnel performing asbestos abatement work shall meet the following training requirements:

1. Class I and II Asbestos Work: Supervisors and Workers must be AHERA trained and shall have current refresher training certificates for asbestos related work.

2. Class III Asbestos Work: Supervisors and Workers shall have received at least 16 hours of asbestos training. Depending upon the work trade such as electricians, plumbers, carpenters, etc., the number of hours of asbestos training may be less than 16 hours, if these trades are not involved in asbestos removal activity. Trade work involving this class of workers may only require a minimum of 6-8 hours of asbestos training for Class III work where they are working in asbestos contaminated work spaces, drilling holes in materials containing asbestos for conduit or pipe installation, attaching to building surfaces conduit, or other minor disturbance to asbestos materials, but not involved in actual removal of asbestos. Removal of small amounts of asbestos such as fireproofing for attachment of hangers for electrical, plumbing or other utilities would require a higher level of training (Class I). All class I work shall be performed by a licensed asbestos contractor.

3. Class IV: Supervisor must be AHERA trained. Workers must have a minimum of “asbestos awareness” level training.

1.08 REGULATIONS

A. The contractor performing asbestos abatement work shall comply with applicable federal, state, local, and University laws and regulations. The list of regulators and regulations, cited below, is not meant to be comprehensive, but to serve as reference for the most...
commonly used standards:

1. **FEDERAL**
   a. EPA
      1) 40 CFR, Part 763, Subpart E – AHERA
   b. OSHA
      1) 29 CFR 1926.1101 - Construction Standard
      3) 29 CFR 1910.147 - Lock Out - Tag Out
   c. NESHAP
      1) 40 CFR 61, Subpart M - Asbestos Emissions
      2) 40 CFR 61, Subpart A
   d. DOT - Regulations

2. **STATE**
   a. Cal/OSHA
      1) CCR, Title 8, Section 1529 – Asbestos Construction Standard
      2) CCR, Title 8, Section 3203 - Injury Illness Prevention
      3) CCR, Title 8, Section 5194 - Hazard Communication
      4) CCR, Title 8, Section 5157 - Confined Space
      5) CCR, Title 8, Section 5208 - General Industry Standard
      6) CCR, Title 8, Section 5144 – Respiratory Protection Standard

3. **LOCAL**
   a. Sacramento Metropolitan Air Quality Management District (SMAQMD)
      1) Rule 902

4. **UCDMC**
   a. Policy and Procedures

1.09 **NOTIFICATION AND PERMITS**

A. Contractor is responsible for notifying federal, state, local agencies, obtaining all required permits/extensions, and bearing all related costs. Contractor shall provide a copy of all notifications and permits to the UCDMC Representative prior to the start of the work and during the project if additional notifications or permits are obtained.

B. **UCDMC**
   1. Hot or Hazardous Material Permit (Call the UCDMC Fire Department at 916-734-3060 for instructions).
   2. EH&S Waste Manifest Protocols (Call EH&S Representative, at 916-734-2740 for instructions). Only EH&S staff will be allowed to sign Waste Manifests.
C. Sacramento Metropolitan Air Quality Management District

1. Provide ten (10) days notification to Sacramento Metropolitan Air Quality Management District (SMAQMD) for any demolition or renovation job with RACM, or materials that will become RACM which exceeds a combined amount of 260 linear feet, 160 square feet or 35 cubic feet. Due to the multiple containments anticipated on this project where fireproofing materials will be removed, the contractor shall be advised that the written notices to SMAQMD will be based on the accumulated amount being removed for the calendar year. It is anticipated that all containments will require written notification 10 working days prior to the work and shall be included in the project schedule. If at least 160 square feet of RACM (such as fireproofing) has already been removed in the calendar year, all subsequent areas (containments) where RACM will be removed will require the 10 day written notice, regardless of the quantity removed.

D. NESHAP

1. The US EPA NESHAP does have jurisdiction on UCDMC projects located outside of Sacramento County; therefore, notification to NESHAP and CARB is required on projects outside of Sacramento County. The East Wing is located in Sacramento County, so the SMAQMD Rule 902 applies.

E. CAL/OSHA

1. Only DOSH registered contractors are permitted to perform class I, II, and III work at UCDMC where removal of asbestos is required. Contractor trades such as electricians, carpenters, plumbers, etc., who have received Class III asbestos training due to the potential for disturbance of asbestos materials are not required to be registered with Cal/OSHA if they are not removing asbestos materials. Drilling holes or attachments to building surfaces that might contain asbestos (such as gypsum wallboard or plaster systems) or accessing an asbestos contaminated work area for example is not considered asbestos removal. Removal of small amounts of fireproofing for attachment and support hangers (if required for the project) shall be performed by a licensed asbestos contractor. Contractor shall provide written notification to the local Cal/OSHA office 24 hours prior to the start of work.

1.10 UNIVERSITY CONTACTS

A. University’s Representative: Dave Brooks
   Phone: 916-734-0221
   FAX: 916-734-7751

B. EH&S Representative: Kaila Benton-Vitz
   Phone: 916-734-2740
   FAX: 916-734-7360
PART II - MATERIALS AND EQUIPMENT

2.01 MATERIALS

A. Safety Data Sheets (SDS)
   1. As specified in the Cal/OSHA Hazard Communication standard (Title 8 5194), the Contractor shall provide safety data sheets (SDS) for all products they use on UCDMC campus. The SDS files shall be submitted prior to the start of the project and shall be located in or near the job site entrance.

B. Surfactants
   1. Contractor may use Foster 32-90, Certane 2075, or equal, for amended water applications. The Foster product is manufactured by H.B. Fuller Co., Foster Products Corporation, Oakdale, MN. The Certane product is manufactured by Certech, Eden Prairie, MN.

C. Encapsulants
   1. The following products or their equals are to be applied using a brush, roller or an airless sprayer, when an encapsulant is required on the project. Contractor shall follow strict manufacturer instructions regarding surface preparation, ambient air retractions, depth of penetration or recommended thickness (dry), and curing time.
      a. For penetrating & lockdown purposes use Foster 32-60 or Certane 909, or equal.
      b. For bridging purposes use Foster 32-32 or Certane 2000, or equal.
      c. For high temperature applications, e.g., steam pipes, use Foster 84-18 or Certane 1000, or equal.

2. Any proposed equal to the products listed above must meet the following criteria: Submit product information prior to the start of the job and receive approval by the University’s Representative with the concurrence of the EH&S Representative; non-toxic and non-irritating as defined by the Hazardous Substance Control Act; sufficiently tinted to provide contrast with the material being coated; and have a minimum 60 lbs./inch Batelle Standard impact rating.

3. All products will be rated UL Class A and have a flame resistance/spread rate less than or equal to 25 as designated by the ASTM code E 162.

D. Polyethylene Bags and Sheeting
   1. Bags and sheeting used for capturing asbestos waste are required to be (1) six
mil thick and (2) meet the following standards: UL Standard No. 263, ASTM E-84, NFPA Standard 701 & 255; and have a flame resistance/spread rate less than or equal to 25 ASTM (E-162).

2. Startex Corp. (Lakeville, MN), North Plastics (Cottage Grove, MN) Bermis Co. (Terre Haute, IN) provide acceptable bags and sheeting. If an equal is proposed, comply with the provisions in 2.1 C 2 above.

3. The contractor will ensure all asbestos waste is properly labeled per Cal EPA, DOT, Cal/OSHA, and EH&S standards prior to disposal.

E. Adhesive Removers

1. All adhesive removers shall meet the Hazardous Substance Control Act standards for non-toxic, low odor, and non-irritating properties.

2. All adhesive removers shall be (a) non-flammable and (b) contain less than 1% (by volume) of any chlorinated hydrocarbon solvents.

3. Whenever possible, adhesive removers shall be mixed into a slurry/paste using diatomaceous earth to control migration through the substrate. This requirement especially applies where there are existing building spaces below the project area.

2.02 EQUIPMENT

A. All HEPA filtered vacuums and HEPA filtered negative air machines shall pass a leak (challenge) test on-site by a firm independent of the contractor before they are allowed to be used on the project. The challenge testing must be witnessed by the UCDHS EH&S or the University's Representative Asbestos Consultant and shall be conducted outside of the building.

B. Tools and equipment shall arrive at the job site free of significant visible debris and dust. No ACM debris shall be allowed to be brought onto the site at any time. All vacuum ports and other openings to negative air units shall be sealed when the units arrive on the project site and sealed when they leave the project site. The Owner or Owners' Representative reserves the right to reject any equipment brought on-site by the asbestos contractor that is deemed contaminated with suspect asbestos materials from a prior project.

C. All electric tools and equipment shall be connected to a GFCI when in use.

PART III - EXECUTION

3.01 SAFETY MEETING

A. In accordance with State and Federal laws, the Contractor is responsible for conditions of the project site, including the safety of all persons and property during the performance of the work. To ensure effective communications in safety matters, the Contractor shall participate and conduct the following meetings:

1. Pre-construction safety meetings may include representatives from the following groups: FD&C, Infection Prevention, EH&S, affected building occupants, general contractor, asbestos subcontractors (if applicable), and representatives of the
The following subjects will be discussed: impact to building occupants, waste disposal, ICRA Permit and compliance, and work related safety programs.

2. On the first day of work, Contractor shall conduct a safety meeting for its employees which alerts them to the specific hazards of the job. The Contractor shall conduct the safety meetings in primary language of its employees.

3. Contractor shall conduct a safety meetings with its employees during the course of the project to discuss health and safety issues related to the project.

3.02 WORK SITE PREPARATION

A. Prior to beginning any on-site work preparation, Contractor shall walk the job area with the UCDMC Project Manager and with the UCDMC Representative Asbestos Consultant to discuss site characterization, ICRA Permit and compliance, regulated area set-up, access controls, security, and safety issues. The contractor is responsible for providing locks and security to the project site to prevent the public and other hospital staff from entering the project area during work hours and during off work hours.

B. In all areas of asbestos related work, including where complete asbestos abatement work will take place to create a “Clean Work” area for subsequent trades and in negative pressure containments where “Hot Work” will take place in asbestos contaminated work areas, the set-up of work containments and engineering controls are exactly the same. All engineering controls are the same for all containments on this project; whether the containment is for full asbestos abatement to create a Clean Work space or in a Hot Work space where all work will be performed within an asbestos contaminated space. Please note the minimum requirement for negative pressure on this project for all containments is -0.030" wp is -0.020" wp. The purpose for the -0.030" wp requirement is because: 1) it can be achieved; 2) it involves asbestos abatement in numerous areas of an occupied hospital where competing air pressures might be problematic; 3) during entry and exit into the containment ante rooms, the negative pressure should never dip below -0.020" wp (a common problem if only -0.020" wp is the criteria); and 4) SMAQMD enforcement personnel are expected to make multiple visits, probably to inspect every containment, since every containment will probably require a formal 10 written notice to SMAQMD.

C. Post all regulatory notices, permits, sign-in/out roster at the primary entrance to the job site.

D. Contractor, in coordination with the University’s PO&M, shall ensure all electrical and HVAC equipment servicing the work area is disconnected and locked out, when possible. Electrical tools in the work zone shall be connected to a ground-fault circuit interrupter (GFCI).

E. The contractor shall seal air tight all HVAC supply and return registers, exhaust registers and other critical openings with tape, double layers of plastic and cardboard or plywood inserts as necessary.

F. Contractor shall ensure all negative air machines and HEPA vacuums are delivered to the site clean and sealed.

G. Contractor shall ensure all HEPA filtration units are challenge leak tested on site and
witnessed by EH&S. Each piece of equipment shall be tested in compliance with the
ANSI Z9.9 Standard (trapping and retaining 99.97% of all particles challenged with 0.3
micron diameter particles). The asbestos contractor shall provide copies of the challenge
tests for all HEPA filtered systems showing proof of passing the challenge test. All HEPA
filtered systems shall have a sticker applied to the surface showing passage of the
challenge test. The company performing the challenge test procedure shall show
evidence of proficiency and training in the test procedure that will be used.

H. In order for the UCDMC Project Manager to conduct timely inspections, Contractor is
obligated to inform the UCDMC Project Manager and the UCDMC Representative
Asbestos Consultant when they are ready to be inspected at least 24 hours prior to the
requested inspection.

I. All Cal/OSHA Class I, II, and III asbestos work shall be conducted within a regulated area
per 8 CCR 1529.

J. Temporary anterooms shall be erected at entrance/exit areas from the construction
work. The anterooms shall be sized to accommodate equipment and materials being
introduced and waste materials being removed from the construction work area. The
plastic separation walls shall be constructed with zipped doors at the entry points. At
least one recording manometer shall be installed at the entrance to the anteroom to
monitor the negative pressure within the construction work area.

K. Where there is work in the attic space, loss of negative pressure will occur when the
ceiling system is opened up. To meet the requirement for -0.030" water column negative
pressure within the anteroom compared to the surrounding non-construction work area,
the following configuration is required when access into the attic space is required.

1. In locations where access to the attic space is necessary and there is limited
space for a large containment, two anterooms shall be erected inside of the
space, attached together with zipped doors

2. The first anteroom is the main entry from the public access or non-construction
zone. It will allow access into the second anteroom that is in the area with the
opened ceiling leading to the attic space. A manometer shall be attached to this
first anteroom. A flexible duct shall be attached to this first anteroom from a
HEPA filtered negative air unit to create a minimum -0.030" water column
negative pressure in the first anteroom.

3. The second anteroom is attached to the first anteroom by means of a zipped
doors. The opening into the attic space shall be sized according to dimensions
prescribed by the Owner. A flexible duct shall be attached to this second
anterior from a HEPA filtered negative air unit to create negative pressure from
the first anteroom.

4. To accomplish the above negative pressure requirements, the contractor may
use one large negative air unit and split the intake duct into two smaller flexible
ducts attached to the two anterooms. The second anteroom shall have the
greater amount of air exhausting from this space compared to the first anteroom
by adjusting the exhaust volume, since it is undesirable to draw air from the dirty
space (second anteroom) into the cleaner space (first anteroom). Use of small
variable speed HEPA filtered negative air units approximately 600-1000 cfm in size are the most effective means of meeting these pressure requirements.

5. To facilitate air pressure in the two anterooms, the contractor shall place on top of the opening to the attic space a piece of drywall, metal or drop-in ceiling panel to partially cover the opening for the majority of the time unless materials and personnel are entering/exitng the attic space. The intent of this cover is to reduce the opening to the attic space in order to increase negative pressure in the two anterooms below.

6. The negative air units shall be exhausted outside of the building via windows or other locations where the exhaust can be directed outside the building envelope.

7. When it is not feasible to exhaust air from the work area out of the building, the contractor shall exhaust the HEPA filtered negative air units into a location deemed acceptable by the Project Manager. The exhaust of the negative air unit may be required to be exhausted into a diffusion chamber constructed with pleated filters making up the diffusion chamber to equality disperse the exhaust air in a broad pattern. This approach is to minimize a high velocity exhaust into occupied areas of the hospital.

8. In locations where there is space for a large work area with the attic space to be opened and accessed, use of two anterooms as described above with a negative air unit attached to the second anteroom will accomplish the goal of creating a minimum of -0.030" wp in the first anteroom with respect to the surrounding non-construction work area.

9. In locations of asbestos abatement with large areas of work, a standard three stage worker decontamination unit is required. Attachment of a small HEPA filtered negative air unit to the dirty room chamber will facilitate the goal of meeting the required negative pressure at the clean room.

3.03 WORK SITE CONTROL

A. Contractor shall restrict the work areas to authorized, trained and protected personnel; including, the Contractor's employees, University Representatives, and state agency representatives.

B. At regulated job sites, the Contractor shall use plastic barriers to demarcate the boundary of the work zone and post on the interior door a warning sign as required by 8 CCR 1529:

   DANGER
   ASBESTOS
   MAY CAUSE CANCER
   CAUSES DAMAGE TO LUNGS
   AUTHORIZED PERSONNEL ONLY
   WEAR RESPIRATORY PROTECTION AND PROTECTIVE CLOTHING IN THIS AREA

C. All unauthorized personnel are to remain outside the regulated area. Contractor is to call
the University’s Representative or the Project Manager if unauthorized personnel enter the regulated area and do not leave upon request by the Contractor.

D. If inclement weather threatens the job site, Contractor shall take all necessary measures to ensure asbestos contaminated debris does not migrate from the regulated areas.

E. If wind speed threatens the job site, Contractor shall erect a wind barrier or suspend operations until the wind is below 15 mph.

3.04 RECORD KEEPING

A. Contractor shall maintain the following records at the regulated work area:
   1. Site Log (sign-in/sign-out for all people entering the containment).
   3. Personal air sampling results including chain of custody forms and laboratory analysis.
   4. Laboratory results from area samples collected inside and outside the regulated area.
   5. Asbestos supervisor and worker training certificates, current respirator fit tests, current medical clearance certificates.
   6. All applicable notifications, including, but not limited to SMAQMD and Cal/OSHA and any revised notifications during the course of the project.
   7. Copies of all Safety Data Sheets for materials present or used on the project.

B. The UCDMC Representative shall retain all records of samples related to the project and report results in the closeout documentation to be submitted at the end of the project.

3.05 ADMINISTRATIVE CONTROLS

A. Asbestos work will be performed after normal working hours (Monday-Friday, 7:00 AM to 5:00 PM), unless otherwise agreed with the Project Manager.

B. Construction work performed in high heat environments requires the Contractor to provide sufficient breaks and drinking water to maintain a safe work environment and to reduce the potential for heat stress.

C. Contractor shall clean the work site before all breaks and at the end of the shift. Asbestos containing materials and debris shall be HEPA vacuumed and wet wiped as necessary daily to maintain a clean work area. At least one HEPA vacuum shall remain inside of the work area every day and available for use during work activities.

D. During the removal process for class I, II and III asbestos work, an AHERA trained Contractor/Supervisor (also defined as a Competent Person) must be on-site. During work in asbestos contaminated attic spaces, an asbestos Competent Person, as defined by T8 CCR 1529, shall be present at all times to oversee safe access and control measures.

E. Prior to trade workers entering a Hot Work area with asbestos contamination, the asbestos Competent Person and asbestos workers shall pre-clean the work space of gross asbestos debris in the area of work to minimize asbestos exposure to subsequent
work by trades. Cleaning of the work space shall include vacuuming gross debris of asbestos fireproofing, pipe insulation or other suspect materials from all horizontal surfaces including top sides of ducts, conduits, pipes etc., where trade workers will come in contact during the course of their work in the asbestos contaminated work area. The intent and goal is to provide a reasonably clean work area for the non-asbestos trade worker (electrician, plumber, carpenter, HVAC technician, steel worker, etc.) before they enter the asbestos contaminated space. This will require coordination with the licensed asbestos contractor to provide these cleaning services in all containments on this project.

3.06 ENGINEERING CONTROLS

A. Negative Pressure Enclosure (NPE)

1. See Section 3.02 describing the required negative air unit configuration to meet the Cal/OSHA requirements for asbestos related work, which requires a minimum -0.030" water column negative pressure between the work area and the surrounding space. All engineering controls are the same in a containment where asbestos is abated to create a Clean Work space where complete asbestos abatement is the goal and in a containment where all work will be performed within Hot Work area that is considered an asbestos contaminated space.

2. A negative pressure enclosure is required when asbestos containing materials are being removed or disturbed on this project site. There will be multiple locations where negative pressure work environments will be required for asbestos abatement. Refer to the drawings and other specifications for locations.

3. There are two types of negative pressure enclosures: full containment and mini-containment. Both containments require proper warning signs in accordance with Cal/OSHA to establish a restricted asbestos regulated area.

4. Full containment for asbestos related work requires the contractor to comply with all provisions in CCR, 8, 1529 and SMAQMD Rule 902. The following items are provided as a reminder of key elements and is not meant to be comprehensive: two layers of six-mil polyethylene on floors, two layers of four-mil polyethylene on walls, three stage decontamination unit with shower, sufficient negative pressure to maintain at least -0.030" of water column pressure differential, clear viewing ports, recording manometer, fire extinguishers, and emergency response protocols.

5. Where removal of the asbestos containing fireproofing is required in spot locations for installation of seismic bracing, and attachment of other mechanical or electrical/piping support, the spot abatement of fireproofing materials, ceiling systems and other asbestos contaminated materials shall be performed only by the asbestos contractor. Fireproofing shall be wetted continuously with water and a wetting agent and removed slowly by a team of at least two employees, capturing the fireproofing into waste containers or pans held up to the underside of the area being abated.

6. The construction of a mini-containment for asbestos work requires at least one layer of six mil polyethylene with zippered doors to restrict airflow and a HEPA filtered vacuum. A negative air unit shall be attached to the mini-containment to maintain negative pressure inside the mini-containment. Comply with all mini-
containment requirements as stated in Title 8 CCR 1529. Mini-containments shall have zippers on the enclosure to allow access to attic spaces, walls or subfloor spaces. Only zippered type partitions will be allowed. The older method of flapped plastic entries will not be accepted.

7. Asbestos related work requiring glove bags to remove asbestos shall comply with the provisions in 8 CCR 1529. The type of glove bag must correspond to the type of activity, e.g., angle glove bags for curved pipe sections, vertical glove bags for vertical pipe, etc. Glove bags must be smoke tested after installed by the Contractor prior to removing asbestos to assure they do not leak. All glove bag work requires at least two people working together as required in Title 8 1529.

8. An Infection Control Risk Assessment (ICRA) Permit will be developed for this project by the University's Representative and approved by the UCDMC Infection Prevention with oversight by EH&S. Depending upon the location of the work and the potential for dust generation that could impact patient care, the ICRA may require more stringent controls than those described under this specification. Adequacy of controls may be verified by periodic airborne particle counting, conducted by EH&S or by a representative of the owner. Contractor understands that any operations generating particles in excess of particle count requirements will require the Contractor to modify the project site engineering controls and work practices. Contractor is responsible for maintaining engineering controls and work practices so excessive airborne particulate is not released.

9. Sticky mats are required to be present in the decontamination unit (first anteroom or clean room as termed in asbestos abatement) and immediately outside of the first anteroom in the non-construction work area. The sticky mats shall be changed on a daily basis to keep them effective at cleaning the soles of the shoes. The sticky mats are a requirement of the ICRA Permit for the duration of the project through completion of all new construction. They will be required through final detail cleaning or final terminal cleaning for each space the construction work activity has impacted.

B. Wet Methods

1. Prior to removing ACM/PACM, the contractor shall adequately wet the material with water that may have an approved surfactant added. Once removed, the waste must be kept wet until it is placed into six-mil asbestos labeled bags. Asbestos debris generated during the project shall remain wetted at all times until the waste debris is sealed into waste bags.

3.07 WORKER PROTECTION

A. The following protective measures are required for asbestos related work associated with this project:

1. Respiratory Protection
   a. Respiratory protection shall be provided to all Contractor employees where there is the potential for exposure to asbestos at or above the permissible exposure limit. In addition, all work in the attic spaces where
there is asbestos containing fireproofing or other asbestos debris, will require workers to wear respirators. Respiratory protection shall be provided at no cost to the Contractor's employees per 8 CCR 1529 and 5144.

b. At a minimum, half-face respirators with P-100 (HEPA) filters shall be provided to all employees required to work inside of the asbestos contaminated spaces. Employers shall provide full-face powered air purifying (PAPR) to those employees who request one at no additional cost to the employee pursuant to 8 CCR 1529. If personal air sampling of specific work practices identify asbestos exposures above the protection factor of a half-face respirator, the contractor will be required to go to a higher level of protection which will include the use of a tight fitting full-face powered air purifying respirator.

c. If personal air samples exceed the protection factor of the respirator, work shall stop for that trade contractor performing the work. Engineering controls and work practices shall be evaluated by the UCDMC Asbestos Consultant to determine reasons for the elevated exposures. Changes to work practices and engineering controls will be required in order for the contractor to begin work again, in addition to the requirement for those employees to wear full-face PAPRs.

d. The asbestos abatement workers shall wear full-face powered air purifying respirators (PAPRs) during removal of fireproofing, ceiling plaster, and other mechanical systems and electrical equipment that is contaminated with asbestos. The contractor shall use the manufacturer's flow meter every day for all respirators at the start of the day and after break periods to make sure the air flow into the PAPRs meet the minimum air flow into the face piece.

e. All workers who wear a respirator shall have passed a respirator fit test within the previous 12 months to perform work on the project. All workers required to wear a tight fitting respirator shall be clean shaven and not have any facial hair interfering or contacting the seal of the respirator with the worker's face. Workers who are observed inside of the asbestos contaminated work area with facial hair contacting the respirator seal will be asked to immediately leave the work area and shall not be allowed to return until clean shaven and a new respirator fit test has been provided and the individual passes.

2. Protective Clothing

a. Workers shall be provided with sufficient sets of protective clothing whenever there is potential exposure to asbestos dust at or above the permissible exposure limit. Tyvek, Kleenguard coveralls, or an equal with attached hood and foot coverings are required. The coveralls shall be available at no cost to the Contractor's employees, UCDMC consultants, and state officials. Disposable coveralls shall be replaced or repaired when they rip or tear or become damaged to the point where they are not providing protection to the worker. At no time shall workers performing work in an asbestos contaminated work area leave the containment while wearing the disposable coverall. The coverall shall be removed inside of the mini-enclosure or work containment prior to the worker exiting the enclosure.

b. At no time shall workers be allowed to leave the general construction
work area in work shoes tracking out dust onto the floor. The ante room shall be used to clean shoes before entering into the adjacent corridors. The sticky mats shall be changed at sufficient frequency and at least daily to minimize tracking out dust outside of the construction work area.

c. Contractor shall provide rubber or latex gloves, rubber boots, eye protection, ear plugs and hard hats as needed per the California Code of Regulations, Title 8, Hazard Communication and Personal Protective Equipment sections.

3. Medical Surveillance

a. As required by 8 CCR 1529, all employers shall establish a medical surveillance program for their employees who may be exposed to asbestos at or above the permissible exposure limit. This requires an asbestos medical exam in accordance with Title 8 1529. All employers shall provide copies of the physician's written opinion for each employee who works on the project pursuant to 8 CCR 1529.

b. Contractor will provide copies of the physician's written opinion for each employee who is required to wear a respirator confirming the ability of the employee to wear a respirator with no restrictions in accordance with 8 CCR 5144. This requirement applies to all employees required to work in an asbestos contaminated space, while wearing a respirator.

c. All workers shall pass the medical examination, FVC, FEV and chest x-ray examinations prior to working on the project.

3.08 PERSONAL HYGIENE

A. No employee will be allowed to consume food, tobacco products or beverage in the regulated work area or any part of the building scheduled for asbestos abatement or in-place management operations. No food containers, water bottles, or any food will be allowed inside of the containment while work is performed under asbestos contaminated work conditions.

B. Contractor shall establish a location outside the work area, which will be designated for employee eating and drinking. Employees must utilize the on-site decontamination facilities prior to entering the designated eating/drinking location. All workers entering the work containment shall wear proper shoes. Tennis shoes are not acceptable.

C. The asbestos contractor shall install a three-stage decontamination unit for the asbestos abatement work and it shall be contiguous with the area that is being accessed. The clean room shall be sized and equipped to adequately accommodate the work crew. Lighting, heat and electricity shall be provided as necessary for comfort. This space shall not be used for storage of tools, equipment or materials (except as specifically designated), or as office space. Shower room shall contain one or more showers as necessary to adequately accommodate workers. The shower enclosure shall be constructed to ensure against leakage of any kind. In addition, the shower shall be a separate unit from the decontamination unit walls. The shower unit cannot be made from poly. Metal or hard plastic is acceptable. The third chamber equipment room (dirty room) shall be sized to accommodate movement of materials, equipment and supplies into and out of the containment work area. All anterooms (decontamination chambers) shall be
separated by zippered doors, not flaps.

D. An adequate supply of soap, shampoo and towels shall be supplied by the Contractor and available at all times. The shower shall provide hot water, which will require the contractor to bring a portable hot water heater for this purpose. Shower water shall be drained, collected and filtered through a system with at least 5.0 micron particle size collection capability. The shower pan in the shower chamber shall be, at least, 3’ x 3’ in size. The shower chamber shall be constructed so that no water from the shower can spray out of the chamber, or any water run down the sides of the poly and miss the pan. The shower chamber dimensions shall be determined by the size of the shower pan but are not to be smaller than 3’ wide by 3’ long by 7’ tall. At least one shower shall be provided for each 10 workers.

E. In Hot Work areas where only spot asbestos abatement is performed or where non asbestos abatement is performed, but work trades are required to work in the asbestos contaminated space, worker decontamination shall include, at a minimum, clean potable water, and clean disposable towels for cleaning face, arms, hands and equipment. All trade workers are required to clean their hands, lower arms, face, respirator and tools before they leave the Hot Work containment area.

3.09 AIR MONITORING PROGRAM

A. Personal Air Samples - Contractor Responsibility

1. The asbestos Contractor must presume Class I, II, and III work will exceed the PEL and conduct air sampling for asbestos in accordance with 8 CCR 1529. The air sampling results will not be used to determine if respiratory protection will be required. Respiratory protection will be required during all asbestos abatement activities and during access at any time into asbestos contaminated spaces, regardless of the air sampling results. The air sampling results will be used to assess the effectiveness of engineering control measures.

2. At least 25% of the asbestos workers per work shift shall be evaluated for asbestos assessment on a daily basis by the Contractor using personal air sampling. The asbestos contractor is responsible for collection of air samples on the various trade workers performing work in asbestos contaminated work spaces.

3. Personal air samples shall be analyzed within 48 hours of collection with results provided to the UCDMC Project Manager Representative, UCDMC EH&S, and the UCDMC Representative's Asbestos Consultant within 72 hours of collection.

4. Sample results shall be emailed to UCDMC Project Manager Representative, Dave Brooks, FAX 916-734-7751; UCDMC EH&S Kaila Benton-Vitz FAX 916-734-7309; and UCDMC Representative's Asbestos Consultant, (Rick Beall, Entek Consulting Group, Inc. FAX 916-632-6812.

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5. Daily monitoring may be discontinued for a particular operation when a negative exposure assessment has shown the operation was performed below PEL for three continuous shifts. This exception does not apply when the scope of the job has changed, ACM/PACM has changed or the UCDMC Representative feels the work protocol is compromised, e.g., less skilled workers are not performing up to standard.

6. In addition to the requirement for personal air samples to be collected during asbestos abatement, personal air samples for asbestos exposures shall be collected of workers in the asbestos contaminated spaces (Hot Work) during asbestos work installing plumbing, electrical, HVAC, ceiling system and other trade work.

7. A Negative Exposure Assessments (NEA) established outside the University is unacceptable. NEAs performed on the campus that “closely resemble” current work shall be considered. Final acceptance of an NEA is made by EH&S and the UCDMC Representative. Review and acceptance of NEAs will not be used to exclude the use of respiratory protection.

8. Air sample results are required to assess the trade workers in the attic space to determine if a higher level of respiratory protection (PAPR) is required additional work practices are required, and if showering by the trade workers will be required. If personal air samples of trade workers exceed the Cal/OSHA PEL, the work shall be halted and an assessment shall be made by the contractor to determine the reason for the elevated concentrations. Additional work practices will be required if personal air sample results for asbestos exceed the PEL and will include more frequent cleaning of the work space and horizontal surfaces by the asbestos Competent Person. A review of the work activity of the trade workers shall be made to determine if there is additional disturbance to asbestos materials that is occurring. If the PEL is still exceeded by the trade workers, then they will be required to shower before leaving the containment. This would require trade workers to be dressed for showering including changing into a bathing suit with disposable coveralls when working in the contaminated space, showering before leaving and dressing into street clothes.

B. Area Sampling

1. Daily Monitoring - University's Representative's Asbestos Consultant Responsibilities

   a. The UCDMC Representative’s Asbestos Consultant (Asbestos Consultant) is responsible for monitoring air quality within the regulated area; including the clean room and immediately outside of the clean room. Any sample at or above 0.1 f/cc in the clean room or outside of the clean room requires a cessation of work until the area is cleaned, the cause of the problem has been determined and remedied. Air samples in the work zone that exceed the protection level of a respirator require a cessation of activity and review of work practices by the Contractor's supervisor and the Asbestos Consultant. The Asbestos Consultant may utilize the asbestos contractor's personal air sampling results to assess the work area air concentrations if the sampling protocol used by the contractor is deemed reliable.
3.10 SPECIFIC WORK PROTOCOLS

A. The specific work protocols are intended as a supplement to the contract provisions. Contractor shall comply with specific work protocols and all other specifications. Where a conflict in specifications exits, the higher standard applies. Not all of the asbestos materials described below might be impacted by the project. They are provided in the event the project expands and the specific materials are impacted.

1. Acoustical Ceiling Tiles (suspended ceiling)
   a. Class II or III
   b. Friable
   c. Respirator Required
   d. No negative pressure enclosure (NPE) if Class III, NPE for Class II, HEPA vacuum, Wet Method
   e. Work Practices:
      1) Remove individual ceiling tiles from grid work using caution not to damage the metal grid work. Protect lighting fixtures and smoke/heat detectors scheduled to remain.
      2) Where removal of metal grid work is required, tie-up lighting fixtures and/or heat/smoke detectors. Removal of metal grid work will include all wire hangers, perimeter and interior grid work.
      3) Where lighting fixtures are scheduled to be removed, clean lighting fixtures and apply a single layer 6-mil plastic or bag and sealed with tape. All lighting fixtures shall be turned over to the University's Representative.
      4) HEPA vacuum and wipe down all exposed surfaces above the ceiling system removed and then apply an approved encapsulant or lockdown material.

2. Acoustical Wall and Ceiling Tiles (glued on – whether the mastic contains asbestos or not)
   a. Class II or III
   b. Friable
   c. Respirator Required
   d. NPE, Wet Method, HEPA vacuum
   e. Work Practices:
      1) Remove tile in small sections capturing individual tiles in a container as close to the point of removal as possible, in order to minimize the amount of material dropping to the floor.
      2) Debris and waste spilled onto floors, ladders or other surfaces shall be cleaned up as soon as possible. Under no circumstances shall debris be left at the end of the workday.
3) Scrape and remove tile adhesive flush with wall and ceiling surfaces.

3. Air Cell Pads
   a. Class I, II or III
   b. Non-friable if intact
   c. Respirator Required
   d. No NPE if Class III, NPE for Class II, Wet Method, HEPA vacuum

4. Asbestos Cement Pipe (intact)
   a. Class II
   b. Non-friable
   c. Respirator Required
   d. No NPE
   e. Work Practices:
      1) Disconnect service to the pipe.
      2) Mark pipe in lengths of approximately six (6) to ten (10) feet or other reasonable length to handle.
      3) Wrap pipe with lagging intact with two (2) separate layers of 6-mil plastic, securely and completely taped.
      4) Disconnect service to pipe being removed.
      5) Place plastic underneath pipe and supports to catch falling pieces.
      6) Carefully supporting all portions of pipe/paneling, break into sections using chain snap cutter or the means of cutting or breaking without creating dust. Power cutters or saws are not acceptable.

5. Glasweld, Wainscot, and Adhesive
   a. Class II or III
   b. Non-Friable
   c. Respirator Required
   d. No NPE if class for class II, HEPA vacuum
   e. Work Practices:
      1) Remove material in manageable sections without sizable quantities of materials dropping to the floor.
      2) Do not sand, grind, blast or mechanically chip or abrade surfaces to remove adhesive.
      3) Scrape wall surfaces to remove excess adhesive flush with wall surface.
4) Wipe down all exposed surfaces prior to applying an approved encapsulant or lockdown material.

6. Gaskets
   a. Class III
   b. Friable
   c. Respirator Required
   d. No NPE Dispose at Class III Land Fill

7. Gypsum Board and Joint Compound
   a. Class II or III
   b. Friable
   c. Respirator Required
   d. NPE, Wet Method, HEPA vacuum
   e. Work Practices:
      1) Remove material in sections manageable without sizable quantities of materials dropping to the floor.
      2) Use a power tools to cut material to be removed with a HEPA vacuum attached to the shroud. Hand cutting with a scoring knife shall be permitted as an alternative option. Keep all cuts moistened to minimize dust.
      3) Keep debris and dropped waste material to a minimum. Under no circumstances shall debris be left at the end of the workday.
      4) Construct mini-containment or attach modified glove bag to wall surfaces; attach materials with taped portion being attached to tape strips applied directly to wall, floor and ceiling surfaces. Allow adequate room for maneuvering of hands within containment.
      5) Spray gypsum board to be removed with water and hand cut perimeter of material to be removed with a knife.
      6) Allow wetted material to drop into bottom of glove bag.
      7) Evacuate air from glove bag and wall cavity using HEPA vacuum; tie off lower section of glove bag prior to spraying wall and ceiling surfaces and cavity with encapsulant.
      8) For locations requiring back to back abatement; leave glove bag or mini-containment in place until work has been completed on both sides of the wall.

8. HVAC Insulation
   a. Class I
   b. Friable
c. Respirator Required

d. NPE, Wet Method, HEPA vacuum

9. Linoleum Floor Backing and Adhesives
   a. Class II or III
   b. Friable
   c. Respirator Required
   d. NPE, Wet Method, HEPA vacuum

10. Paints (textured)
    a. Class II or III
    b. Friable
    c. Respirator Required
    d. No NPE if class III, NPE for class II, HEPA vacuum, Wet Method

11. Plaster (interior and exterior)
    a. Class II or III
    b. Friable
    c. Respirator Required
    d. No NPE if class III, NPE for class I, HEPA vacuum, Wet Method
    e. Work Practices:
       1) Remove plaster material in manageable sections without sizable quantities of materials dropping to the floor.
       2) Work shall include removal and disposal of plaster, expanded metal mesh and non-structural ceiling joists. Bag all materials as removed. Tape sharp edges as needed to prevent the bag from being punctured.
       3) Do not use power tools to cut material to be removed. Keep all cut material edges and surfaces moistened to minimize dust.
       4) Keep debris and minor dropped waste to a minimum, and immediately moisten and clean up. Under no circumstances shall debris be left at the end of the workday.
       5) HEPA vacuum and wipe down all exposed surfaces to remain prior to applying an approved encapsulant or lockdown material.

12. Rubber Cove Base Adhesive
    a. Class II or III
    b. Non-Friable
    c. Respirator Required
d. No NPE if class III, NPE for class II, HEPA vacuum, Wet Method

e. Work Practices:

1) Provide protective splash barriers for all wall surfaces. Contractor shall provide decontamination systems at all personnel exits from the work area.

2) Remove material in manageable sections.

3) Do not sand, grind, blast or mechanically chip or abrade surfaces to remove adhesive.

4) Scrape off excess adhesive flush with wall surface.

5) Wipe down all exposed surfaces prior to applying an approved encapsulant or lockdown material.

13. Soil (asbestos contaminated)

a. Class II or III

b. Friable

c. Respirator Required

d. No NPE if class III, NPE for class II, HEPA vacuum

e. Work Practices:

1) All foundation vents, grates and other openings will be securely sealed with plastic and tape.

2) Contractor shall set grade stakes on minimum fifteen (15) foot centers throughout the area from which soil is to be removed.

3) Contaminated soil shall be dampened and kept damp during removal operation.

14. Steam/Hot/Cold/Chiller Pipe Lagging (horizontal, vertical, joints, valves)

a. Class I or III

b. Friable

c. Respirator Required

d. NPE, Wet Method, HEPA vacuum

e. Work Practices

f. Class III Work Practices:

1) Contractor shall comply with UCD access protocols, which requires respirator and double suit.

2) Apply duct tape completely around the pipe at point where glove bag will be attached.

3) Silt glove bag down sides; install on pipe with taped portions being attached to tape strips applied to pipe. Allow adequate room for maneuvering of hands at top of glove bag.

4) While assistant sprays lagging continuously with water amended with surfactant, cut lagging around its circumference using handsaws, knives, or other cutting tools.
5) Remove wetted lagging, drop into bottom of glove bag.
6) Clean surface under section of removed lagging using toothbrush, towel, etc.
7) Evacuate glove bag using HEPA vacuum cleaner; tie off glove bag.
8) Remove glove bag from pipe. Seal glove bag using at least two closures. Seal exposed lagging ends with bridging agent and Carlisle Hardcast wettable cloth or equivalent.

g. Class I Work Practices
1) Set up full containment
2) Establish baselines and conduct area monitoring throughout the project.

15. Transite (siding, shingles, furnace flue, and duct)
   a. Class II or III
   b. Friable and Non-friable
   c. Respirator Required
   d. No NPE, Wet Method
   e. Work Practices:
      1) Provide plastic on the horizontal surface below the area of work extending out sufficient to capture material being removed.
      2) Remove material in manageable sections and lengths without sizable quantities of materials dropping to the floor or ground using wet methods.
      3) Where possible, remove mechanical fasteners without any abrading of transite material.

16. Floor Tiles, Rubber Cove Base and Adhesive
   a. Class II or III
   b. Non-friable
   c. Respirator Required
   d. No NPE if class III, NPE for class II, Wet Method, HEPA vacuum
   e. Work Practices:
      1) Flooring shall be removed only by hand or mechanical methods which do not create dust. These include dry ice/blanket, hand and power scrapers, spud bars, etc. Do not sand, grind, blast or mechanically chip or abrade.
      2) Adhesive shall be removed only by wet methods or by approved solvent.

17. Window Putty
   a. Class II or III
b. Friable

c. Respirator Required

d. No NPE, Wet Method, HEPA vacuum

e. Work Practices:

1) Provide plastic on the horizontal surface below the area of work extending out sufficient to capture material being removed.

2) Remove material in manageable sections and lengths without sizable quantities of materials dropping to the floor or ground using wet methods.

18. Above Ceiling Work - Areas with Asbestos Containing Fire Proofing or Pipe debris

a. Class I or II

b. Friable

c. Respirator Required

d. NPE, Mini-containment

e. Work Practices:

1) Use of a respirator, disposable protective coverall, and gloves are required to enter above the ceiling.

2) A mini-containment or other NPE must be set up and used by employees to safely enter the attic space above the ceiling system. The mini-containment/NPE must be kept under negative pressure using at a minimum a HEPA vacuum that has been certified within the last year or last filter change, whichever is more recent. A three stage decontamination unit with a shower is required when more than 10 square feet of fireproofing are removed.

3) Clean the entry area above the ceiling with a HEPA vacuum before completely entering the space.

4) If practical, vacuum visible insulation debris for the full path of travel. If this is not practical the employee must use other procedures to ensure safe removal of visible insulation debris in the path of travel that would be disturbed by the crawl. For example, wet paper towels and plastic bags may be used to pick up and contain visible debris. Other control methods may be used provided they meet the following criteria:

   a. dry sweeping is not permitted

   b. employees must not walk on, crawl on or otherwise crush visible clearly recognizable insulation debris

   c. the control method must not result in a release of airborne fibers

5) If disposable coveralls get torn during the work activity, immediately repair the torn coverall with duct tape or exit the
area and put on a new coverall. Before leaving the mini-containment inspect the personal clothes and shoes/boots of any person that entered the above ceiling area and remove any visible debris using the HEPA vacuum.

6) Upon completion of work at that location, inspect the floor where the mini-containment was set up and remove any debris using the HEPA vacuum.

3.11 INSPECTIONS

A. Inspection Responsibilities - Contractor

1. Prior to beginning any asbestos-related work, Contractor's asbestos supervisor shall inspect the regulated work areas for any building damage, hazardous conditions, and/or irregularities that may contribute to an unsafe work environment. Any condition that poses a hazard or potential hazard to the Contractor's employees or the University community must be immediately reported to the UCDMC Representative.

2. Contractor is responsible for monitoring and enforcing all requirements of this specification. This responsibility includes communicating scheduling changes to the UCDMC Representative to allow inspections at each phase of the project.

3. Contractor shall provide protocols for responding to loss of negative pressure after they have left the job site. Under no circumstances shall Contractor shut off negative air machines at the end of the shift, unless the job has received final clearance. Emergency mobile telephone numbers shall be provided of key asbestos Supervisors on the project to the University's Representative in the event they need to be contacted after off hours.

4. At the end of each shift, the Contractor shall adequately wet waste, collect all loose debris, place it in double 6 mil poly bags, and label the material. The asbestos waste may remain inside the containment, provided access controls are secure. If the Contractor cannot guarantee access control, the asbestos waste must be secured in a locked storage container.

5. The Contractor supervisor shall perform a thorough pre-final visual of the containment work area and adjacent surfaces prior to requesting that the University's Hazardous Materials Representative conduct a final visual inspection. The pre-final visual performed by the Contractor shall verify that all materials have been completely removed from the work area.

B. Inspection Responsibilities – UCDMC Representative Asbestos Consultant (Asbestos Consultant) Responsibilities

1. Shall walk the job site with the Contractor to review pre-cleaning operations and any safety or security issues and may attend contractor safety meetings.

2. Shall verify pre-cleaning was performed in accordance with the specifications.

3. After the Contractor has completed set-up and before commencing operations, the Asbestos Consultant shall check completeness of the following items: regulated area is demarcated and posted with Cal/OSHA asbestos warning signs, permits are posted, poly sheeting is six mil, double layers, all HEPA equipment is challenge leak tested and passed the challenge tests, electrical
tools are connected to GFCI, HVAC is shut off and all supply and return registers (if possible), exhaust registers are sealed with six mil poly, electrical panels are tagged and locked out (if possible), electrical outlets are sealed with 6 mil poly, a fire extinguisher is available outside the containment, and water connections are made with a back flow prevention device. If a NPE is used, the inspector will verify: a minimum of -0.030” of water pressure is maintained, three-stage decontamination is sealed and air flow is correct, and the shower is functioning with a hot water heater, soap, shampoo, and disposable towels.

4. Prior to asbestos abatement or in-place management activities beginning, the Asbestos Consultant shall match on-site personnel with asbestos training certificates, fit tests and medical exam records. Workers without current and valid on-site documentation shall not be allowed in the regulated area.

5. The Asbestos Consultant is responsible for reviewing all samples and alerting the UCDMC Representative, EH&S staff and the UCDMC Project Manager if any persona or area air samples exceed 0.1 f/cc.

6. During abatement or in-place management activities, the Asbestos Consultant shall check for the following: all personnel are signing in and out, wet methods are being used, debris is collected at the end of each shift, workers are properly wearing disposable coveralls and respirators, and work is performed in a safe manner.

7. The Asbestos Consultant shall file a report with the UCDMC Representative and UCDMC Project Manager in the frequency desired by both.

8. When only spot removal of fireproofing is performed for attachment of bracing, etc., clearance air sampling is not planned for the small spot abatement work in the attic space.

9. In the event of asbestos abatement when encapsulation is required, the following will apply. After abatement or in-place management activities are complete and before lockdown or encapsulant is sprayed, the Asbestos Consultant shall verify: completeness of abatement or in-place management work by conducting a thorough visual inspection of the work area, confirm and approve the lockdown (encapsulant) being used, and confirm all SDS are on-site for materials used by the contractor.

10. Shall review clearance protocols with the Contractor prior to clearance monitoring. If clearance is not achieved, the Contractor shall re-clean the containment area prior to re-sampling the regulated area. All re-sampling costs due to clearance monitoring failure are the responsibility of the contractor.

11. After clearance has been achieved the Asbestos Consultant shall ensure the work area is clean and free of all equipment, all waste has been removed in accordance with University protocols, keys are returned and the Contractor has restored the room to its original condition or to an otherwise agreed upon state.

3.12 CLEAN-UP

A. Daily Clean-Up

1. The project work area shall be cleaned on a regular basis. The interior of the anterooms shall be free of all visible debris and materials. At the end of each
work shift, the floor of the anterooms shall be HEPA vacuumed or wet wiped or both to remove all debris from the plastic surfaces. The sticky mats shall be change on a regular basis to be effective.

2. All asbestos debris shall be adequately wetted, collected, and placed into two 6 mil plastic bags with Cal/OSHA asbestos warning labels attached. Additional labeling requirements will be required for friable waste materials. Excess air shall be HEPA vacuumed from the bag, and shall be closed in a goose-necked fashion and secured with tape. No bag shall exceed a gross weight of 30 lbs.

3. Materials exceeding the size of a 60" bag may be sealed in “burrito” wrap fashion which requires the materials to be adequately wetted, then double wrapped in 6 mil plastic sheeting and sealed air tight with tape, Cal/OSHA asbestos warning labels attached or the black diamond label, generator name and address and Waste Manifest number attached if the waste is friable asbestos materials.

4. At the end of each work shift, all asbestos waste shall be secured in a locked container. The containment shall also be made secure such that unauthorized access is not allowed during off-work hours.

B. Final Clean-Up

1. HEPA vacuum all visible debris and dust on the inner (top) layer of poly.
2. Wipe down interior surface of the inner (top) layer of poly of all gross asbestos debris.
3. Remove inner (top) layer of poly and dispose as asbestos waste.
4. HEPA vacuum or wipe all visible dust and debris from the outer (bottom) layer of poly.
5. Apply encapsulant inside of the entire containment area.
6. Remove the outer (bottom) layer of poly and clean all visible dust and debris that is present behind this poly shall be cleaned by HEPA vacuuming and wet wiping. At this time only the critical barriers shall remain in place with the building finishes exposed and in need of final detail cleaning. Floor and wall poly shall be removed prior to the clearance air sampling, unless specific changes have been approved by the Asbestos Consultant.
7. After all gross asbestos material has been removed, and after a final visual inspection has been found acceptable and passed by the asbestos consultant, the contractor will be allowed to spray the lockdown encapsulant throughout the work area.
8. When step 7 is achieved, the area is ready for clearance sampling with the critical barriers and decontamination unit left in place with the work area still under negative pressure.

3.13 WASTE DISPOSAL

A. The Contractor shall propose their choice of hazardous waste site that accepts asbestos to EH&S and obtain EH&S approval of the hazardous waste site before the Contractor ships off the waste material. EH&S must be contacted at least five working days prior to the date of first shipment.
1. Contractor shall comply with all waste protocols established by EH&S. These protocols explicitly require Contractor to properly complete the Uniform Waste Manifest form. Failure by Contractor to complete Contractor's portion of the form shall result in the Contractor assuming the fine imposed by the responsible agency.

B. Packaging Asbestos Waste

All asbestos containing waste material must be packaged in one of three ways: (1) placed in two 6 mil clear polyethylene bags that are sealed with the "gooseneck" style, (2) placed in one 6 mil clear polyethylene bag and then placed into a sealed drum (DOT approved) or (3) double wrapped in 6 mil polyethylene sheeting (AKA "burrito style").

C. Labeling Asbestos Waste

Each bag, drum, or "burrito" wrap shall have a label affixed with the following information: (1) Hazardous Waste warning, (2) Generator’s Name, address, and phone number, (3) Location information, e.g., Building, department, room, (4) manifest document number, and (5) date. Contractor can generate the label or use bags with label information stenciled on the side. For non-hazardous asbestos waste, a Hazardous Waste Manifest is not required; however, at a minimum, the Cal/OSHA asbestos warning label is required per Title 1529.

D. Transporting Waste

All sealed waste bags removed from the work area containment shall be transported inside of closed leak tight plastic bins with lids on wheels that can be rolled from the project area in the building to the waste bin located outside of the building. The door of the waste bin shall have the required asbestos warning sign attached and visible during all loading of the asbestos containing waste.

E. Storing Asbestos Waste Outside of a Building

At the end of each shift, all asbestos waste shall be stored in a locked container or shipped off site. Accumulated waste shall not be allowed to remain in the regulated work area overnight, unless prior approval is provided by EH&S. No container shall be allowed to remain on site for greater than 90 continuous days from date the first asbestos waste container was generated.

F. The Waste Identification Notice and Certification must be completed by the Contractor to comply with waste stream identification requirements (Title 22, CCR). The Waste Identification Notice and Certification form can be obtained from EH&S.

G. Uniform Waste Manifest Procedures
Prior to transporting waste from the project site to a disposal facility, the Contractor shall prepare a California Uniform Hazardous Waste Manifest (form DTSC 8022A). After completing Contractor's portion of the form, Contractor shall return the Manifest to EH&S for signature between the hours of 8:00 AM to 5:00 PM Monday to Friday, and will require a 24 hour notice to EH&S for the signature. Only authorized EH&S personnel can sign on behalf of the University (generator). The Generator is UCDMC. EPA ID No. CAD076124981. The Generator address is 2315 Stockton Blvd., FSSB 2500, Sacramento, CA 95817.

H. Contractor shall complete the Waste Shipment Record supplied by EH&S.

The three forms (Waste Identification, Uniform Waste Manifest, and the Waste Shipment Record) must be submitted together as a single approval request to EH&S.

J. Transporting Asbestos Waste

A registered waste transporter, hired by the Contractor, is responsible for transporting asbestos waste from the project site to a disposal facility permitted for asbestos waste. The landfill has to be approved by UCDMC EH&S, who requires seven (7) day's notice to review and approve the landfill. The transporter must make pick-ups during normal working hours (8:00 AM to 5:00 PM Monday through Friday). The transporter's vehicle must be clearly marked with warning signs. To avoid illegal transport of asbestos waste, Contractor is responsible for knowing if the job site is contiguous with the main University campus. If Contractor must cross public streets to load asbestos waste in the container, the Contractor must comply with Sacramento Metropolitan Air Quality Management District (SMAQMD) requirements.

K. Record Keeping

The University's Representative is responsible for assisting EH&S with collecting all documents related to waste disposal operations.

L. Fees

Contractor is responsible for all fees and charges related to waste disposal operations; including, waste steam profiles. Refer to SW-846-1311 (TCLP) and CCR, Title 22 Section 66261 (STLC) for identification requirements.

3.14 CLEARANCE PROTOCOL

A. Project Specific

1. The clearance protocol to be used shall be clearly stated and communicated in advance of the UCDMC Hazardous Materials Representative beginning the clearance procedure.
a. All containment areas of asbestos abatement will have clearance air samples analyzed by TEM per the AHERA analytical method. The exception to this is when very small amounts of asbestos are removed, or for example when spot asbestos removal or fireproofing materials is conducted in the attic space. In these cases, clearance air sampling might not be conducted.

B. PCM Clearance Method

1. PCM analysis for clearance air samples will not be used on UCDMC projects.

C. TEM Clearance Method (Where Used or Required)

1. The TEM analytical method is the primary method that will be used on UCDMC asbestos abatement projects. Clearance protocol for TEM Method shall conform to EPA AHERA standard pursuant to 40 CFR Part 763, Appendix A to Subpart E TEM analytical methods, with the exception that fewer number of air samples may be collected and analyzed.

2. Air samples shall be collected on MCE cassettes with a 0.45 micron pore size.

3. The Contractor may elect to sample first with PCM to get an indication of the level of cleanliness.

4. After the lock down/encapsulant is settled and dry, a leaf blower will be used to agitate all surfaces within the negative pressure enclosure (referred to as the aggressive air sampling method). One or more free standing 24” fans will be placed inside of the work area to facilitate additional air movement inside the containment for the duration of the air sampling period.

5. The clearance criteria shall be the AHERA standard. The average of all air samples collected inside of the work area shall be ≤70 asbestos structures per millimeter squared. If the clearance criteria is not met, the Contractor is responsible to re-clean the entire containment area, and the UCDMC Representative shall collect clearance air samples again. Air sampling shall continue until the sample results meet the clearance criteria. All additional cleaning of the containment by the contractor and additional costs for the collection and analysis of the air samples will be at the expense of the contractor.

3.15 PROJECT CLOSE OUT

A. Before the final certificate for payment is issued to the Contractor the following information shall be provided to the University’s Representative:

1. Provide post job submittals to include:

   a. Contractor’s name, address, CSLB certification number, DOSH registration number, and tax identification number.

   b. Name of hazardous transporter, address, phone number and registration number.

   c. A copy of the asbestos waste records showing dates, times, manifest numbers, quantities of wastes, types of containers removed from the work area, the hauler, and the signature of the recorder.

   d. Name, address, phone number and EPA registration number of waste disposal site.
e. Copies of all laboratory analysis of air samples.
f. Building name and address.
g. Project name and contract number.
h. Describe scope of work; including, location (room numbers, approximate square footage, building system types).
i. Provide an inventory of the ACM/PACM removed from the job site. Include, building system, classes of asbestos related work, quantity, note whether the project was abatement or managed in-place, note whether the building system(s) was replaced.
j. A copy of the worker/visitor logs showing the following for all persons entering the work area: date, name, entry time, exit time, company or agency represented, and reason for entry. The Contractor's time records will not be accepted in lieu of a worker/visitor log.
k. Dates on-site work began.
l. Dates on-site work was completed.
m. Copies of DOP Testing Performed on HEPA Equipment not Previously Submitted
n. Manometer graphs identifying project name, date, and location.
o. Copies of all accident reports submitted during the course of work. If no accidents occur during the project this should be stated in writing by the Contractor.
p. Copies of revised notifications to all regulatory agencies.
q. Other Documents as Requested

END OF SECTION 02 82 00
SECTION 02 83 00
HAZARDOUS MATERIALS MANAGEMENT – LEAD & OTHER HAZARDOUS MATERIALS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. WORK INCLUDED - GENERAL

1. The Contractor shall furnish all labor, material, equipment, services, testing, employee training, fit testing, medical exams, transportation, and daily expense to meet the requirements of this Specification.

2. The Contractor shall obtain all required permits, licenses, registrations, notifications, and regulatory approvals required by law (federal, state and local) and University of California Davis Medical Center (UCDMC) policy.

3. All lead-related activities associated with this Contract shall be performed during the work period specified in each contract.

4. The Contractor shall guard against unnecessary disturbances or damage to sensitive finishes on buildings, building systems, and equipment.

B. WORK INCLUDED - SPECIFIC

1. The Contractor is responsible for identifying the exact locations and number of work areas listed below by referring to University supplied Project Drawings and by working with the University’s Representative or University’s Hazardous Materials Consultant.

2. This project does not include lead abatement or lead remediation. This project includes work on building components that have been tested where lead is present in the paint in low concentrations which would indicate there is some “lead containing material” (LCM), and some materials above 1.0 milligram per square centimeter (mg/cm²), which is considered “lead-based paint” (LBP). This project is a renovation project and not considered a lead abatement project with regards to the requirements of Title 17.

3. Please note when reviewing XRF test data, not every building surface in every room was tested for lead. The purpose of the surface testing for lead is to determine the general range in findings for lead in the paint. Measurements of lead found to be less than 1.0 mg/cm² (including measurements of 0.0 mg/cm²) still have low levels of lead and Cal/OSHA work practices per 8 CCR 1532.1 for lead still apply.

1.2 SITE CHARACTERIZATION

A lead in paint inspection and asbestos inspection report “East Wing Hazardous Materials Survey Report” prepared by MACTEC Engineering and Consulting, Inc., November 29, 2005 and the MACTEC “North/South Wing Hazardous Materials Survey Report”, November 29, 2005 are attached as an Exhibit. These inspection reports includes an assessment for hazardous materials including asbestos, lead in paint, fluorescent light tubes and ballasts containing PCB’s. Subsequent asbestos and lead in paint inspections have been conducted by Entek Consulting Group, Inc. with reports provided on July 19, 2017, September 15, 2017, and June 1, 2018 (June 13, 2018 Revision) are attached as an Exhibit. The contractor shall refer to all inspection reports for locations were asbestos has been identified in the East Wing and North/South Wing, which are attached as an Exhibit to 02 82
A. Hazardous materials, other than lead containing paints and Presumed Lead Containing Materials (PLCM) that have the potential to be disturbed at this Project site are listed in the table below:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>Type of Hazard</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorescent Light Bulbs</td>
<td>Mercury</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Light Ballasts</td>
<td>PCB's</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Light Ballasts</td>
<td>Universal Waste</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Mold Contamination</td>
<td>Mold</td>
<td>Undetermined</td>
</tr>
<tr>
<td>Caulking</td>
<td>PCB's</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Thermostat Switches</td>
<td>Mercury</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Building Components</td>
<td>Asbestos</td>
<td>See Section 02 82 00</td>
</tr>
<tr>
<td>Exit Signs</td>
<td>Radioactive Gas</td>
<td>See Drawings</td>
</tr>
<tr>
<td></td>
<td>Tritium</td>
<td></td>
</tr>
</tbody>
</table>

1. Where “See Drawings” is noted in the above table or elsewhere in this specification; refer to the Exhibits.

B. Where light fixtures are required to be removed, the Contractor shall recycle all fluorescent light tubes and non-PCB containing ballasts as Universal Wastes as required in Title 22. All PCB containing light ballasts or caulking (if present) shall be sent to a hazardous waste site as a separate waste stream. Determination of potential PCBs for each light ballast shall be made when the light fixture is removed from the building component. Packaging of light tubes and light ballasts shall be in accordance with regulatory standards for safe storage and transport by a hazardous waste hauler.

C. Prior to handling other hazardous materials at the Project site, the Contractor shall review University’s protocols with a UCDHS EH&S Representative.

1.2 ABBREVIATIONS AND DEFINITIONS

A. Abbreviation

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>Atomic Absorption – Flame (EPA SW-846)</td>
</tr>
<tr>
<td>ABATEMENT</td>
<td>Removal of all Lead in the Building/Location or Specific Component</td>
</tr>
<tr>
<td>AIHA</td>
<td>American Industrial Hygiene Association</td>
</tr>
<tr>
<td>AL</td>
<td>Action Level (30 (\mu g/M^3) per 8 hour TWA)</td>
</tr>
<tr>
<td>BLL</td>
<td>Blood Lead Level</td>
</tr>
<tr>
<td>CCR</td>
<td>California Code of Regulations</td>
</tr>
<tr>
<td>CDPH</td>
<td>California Department of Public Health</td>
</tr>
<tr>
<td>CEPA</td>
<td>California Environmental Protection Agency</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>CSLB</td>
<td>Contractor's State Licensing Board</td>
</tr>
<tr>
<td>DIR</td>
<td>Division of Industrial Relations</td>
</tr>
<tr>
<td>dL</td>
<td>Decilitre</td>
</tr>
<tr>
<td>DOSH</td>
<td>Division of Occupational Safety and Health</td>
</tr>
<tr>
<td>DOT</td>
<td>Federal Department of Transportation</td>
</tr>
<tr>
<td>DTSC</td>
<td>California Department of Toxic Substances Control</td>
</tr>
<tr>
<td>EH&amp;S</td>
<td>Environmental Health and Safety - UCDHS</td>
</tr>
<tr>
<td>ELLAP</td>
<td>Environmental Lead Laboratory Accreditation Program</td>
</tr>
<tr>
<td>ELPAT</td>
<td>Environmental Lead Proficiency Analytical Testing Program</td>
</tr>
</tbody>
</table>
B. Definitions: The following definitions are provided for additional clarification and may exceed Federal, State or local regulatory requirements.

1. Lead Abatement - “Abatement” means any set of measures designed to reduce or eliminate lead hazards or lead-based paint for public and residential buildings, but does not include containment or cleaning.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23 Shop Drawings, Product Data and Samples, and Section 01 77 00 Closeout Procedures.

B. Submit proposed material substitutions complying with requirements listed in Section 01 60 00 Product Requirements.
C. References: Submit names, addresses and telephone numbers of at least 3 Project Managers or Owners (not employed by Contractor) for whom Contractor has performed jobs of similar size and character to the work specified in this Contract.

D. General: Submittal requirements listed below shall be completed and accepted by University's Representative prior to scheduling the start of project site work. Submit the number of copies Contractor requires, plus 4 copies that will be retained by the University. Work shall not begin until such approval has been given, and a bound copy of project submittal is placed at an easily accessible location at the project site.

E. Notifications and Permits: Submit copies of all regulatory agency notifications and permits.

1. Contractor is required to submit a "Lead-Work Pre-Job Notification" (8 CCR 1532.1(p)) for all projects, if there is greater than 100 square feet or greater than 100 linear feet of materials containing lead greater than 5,000 ppm, 0.5% by weight, or 1.0 mg/cm² to be removed. If these quantities are exceeded, a copy of the notification to Cal/OSHA shall be provided to the UCDHS EH&S Representative.

F. Worker Training and Safety Programs

1. Training Certificates: For each employee who will be employed on the Project, submit a copy of employee's lead training that meets Cal/OSHA training requirements under Title 8 Section 1532.1 Lead in Construction. UCDHS requires all contractor and subcontractor personnel directly involved with lead abatement to have current CDPH lead training certificates at a level appropriate for the project task (e.g., Project Designer, Project Monitor, Supervisor, Worker, Inspector/Assessor), in the unlikely event that lead abatement is required for the project.

2. Qualifications of person taking Personal Air Samples: Submit information regarding training and qualifications of the field technician who will be collecting personal air samples.

G. Safety Programs: On company letterhead, submit confirmation that the Contractor has written safety programs for:

1. Injury Illness Prevention (T8 CCR 3203) (mandatory for all projects),

2. Hazard Communication (T8 CCR 5194) (mandatory for all projects),

3. Fall Protection (T8 CCR 1620 – 1621, 1632 – 1633, 1635.1 – 1637, 1640 – 1655, 1669 – 1672, 3209 - 3239) (when applicable),

4. Lock Out Tag Out (T8 CCR 3314) (when applicable),

5. Confined Space (T8 CCR 5156) (when applicable),

6. Respiratory Protection (8 CCR 5144) (when applicable)

7. Medical Surveillance (8 CCR 1532.1(i)) (when applicable)

8. Lead Compliance (8 CCR 1532.1(e)(2)) (when applicable)
H. Work Plan and Schedule: Submit proposed Work Plan and schedule. The Work Plan shall be project specific and address project site preparation, site and engineering controls, worker protection and exposure monitoring, and protection of building occupants from exposure to lead. Schedule of work must be submitted and approved before work begins. University's Representative will forward a copy to the Hazardous Material Consultant for review prior to commencement of work.

I. Product Data Sheets and Safety Data Sheets (SDS): For all products proposed for use on the project, submit copies of the manufacturers' safety data sheets to the UCDHS EH&S Representative for review, and copies of the Product Data Sheets to the University Representative for review.

J. Laboratory Qualifications: For any laboratory performing lead analysis the Contractor shall submit evidence of ELLAP and ELPAT certification and accreditation. Laboratories performing worker exposure sample analysis must submit evidence of AIHA IH-LAP certification for metals if they do not have ELLAP or ELPAT certification.

K. HEPA/ULPA Equipment Test: Submit copies of leak test results to the University's Representative prior to starting project site work. Leak testing shall be performed at the project site outside of the building and shall be witnessed by the UCDHS EH&S Representative or the Hazardous Materials Consultant. The leak test results shall identify equipment by make, model and serial number. Vacuums which fail may be used within full negative pressure enclosures at the discretion of UCDHS EH&S.

L. Emergency Contact List: Submit an emergency contact list; include name, phone number, fax number and pager number for Contractor's supervisor or competent person and subcontractor's telephone numbers who can be reached on a 24-hour basis.

M. Hazardous Waste Disposal Plan: Submit a Waste Disposal Plan that includes estimated number of containers), size of container(s), hazardous material transporter name and proposed disposal site before start of project. The disposal facility must be approved by the UCDHS EH&S representative prior to off-haul.

N. Lead As-Built Summary: Submit a Lead As-Built Summary within 14 calendar days of the last day of field Work and prior to a request for final application for payment. The summary shall include a description of lead containing materials that were removed and a description of lead containing materials that remain in the project area.

1.4 CONTRACTOR QUALIFICATIONS

A. Contractor licensing for this work will require a B, C33, C22 or C61/D-38 and appropriate lead training for employees to perform lead related work.

1.5 RULES AND REGULATIONS

A. The Contractor shall comply with the most recent edition of applicable Federal, State, local, and University standards, laws, codes and regulations. If a conflict exists between referenced regulatory requirements and Contract Documents, the Contractor shall notify the University's Representative in writing and request the conflict be resolved. Contractor performing work contrary to mandated laws shall bear full legal and financial responsibility for the violations.

B. The list of regulators and regulations, cited below, serve as a reference for the most commonly used standards governing the lead industry:
1. FEDERAL REGULATORS AND REGULATIONS
   a. EPA - Environmental Protection Agency
      (1) 40 CFR Part 261 et al. - Resource Conservation and Recovery Act
      (2) Title X - Residential Lead Poisoning Prevention Act
      (3) National Ambient Air Quality Standards (40 CFR 50)
   b. OSHA - Occupational Safety and Health Administration
      (1) 29 CFR 1926.62 - Construction Lead Standard
      (2) 29 CFR 1910.1025 - General Industry Lead Standard
      (3) 29 CFR 1910.147 - Lock Out - Tag Out
   c. DOT - Department of Transportation
      (1) 49 CFR Parts 173, 178 and 179

2. STATE REGULATORS, LAWS AND REGULATIONS
   a. Cal/OSHA - California Division of Occupational Safety and Health
      (1) 8 CCR 1532.1 - Construction Lead Standard
      (2) 8 CCR 5216 - General Industry Lead Standard
      (3) 8 CCR 5194 - Hazard Communication
      (4) 8 CCR 5157 - Confined Space
      (5) 8 CCR 5144 - Respiratory Protection
      (6) 8 CCR 3203 - Injury and Illness Prevention
   b. DTSC - Department of Toxic Substances Control
      (1) (Health and Safety Code Chapter 6.5 Hazardous Waste Control, Article 6 Transportation and Article 6.5 Hazardous Waste Haulers
      (2) CCR, Title 22, Division 4, Sections 66000, et al.
   c. CIWMB - California Integrated Waste Management Board
   d. California Department of Public Health (CDPH)
      (1) CCR, Title 17, Division 1, Chapter 8
   e. SWRCB State Water Resources Control Board - CCR, Title 23
   f. CSLB - California Contractors State License Board
   g. Health and Safety Code 25157.8 (AB 2784 Natural Resources)

1.6 NOTIFICATION AND PERMITS

A. The Contractor is responsible for notifying Federal, State and local agencies, obtaining all required permits/extensions and paying all related fees, as required.

B. UC Davis Health System

1. To obtain a Hot Work Permit from the UCDHS Fire Protection Office, call 916-734-3036 for instructions.

2. A Uniform Hazardous Waste Manifest shall be prepared by the Contractor or the transporter and approved by UCDHS EH&S for each load of hazardous waste transported from the work site. EH&S must notified at least 24 hours prior to the anticipated time of shipment.

3. Copies of records of non-hazardous waste removed from the project shall be provided to UCDHS EH&S, which may include Bill of Lading, non-hazardous waste receipts, etc.

C. Sacramento Metropolitan Air Quality Management District (SMAQMD) has no notification requirements for lead related work. SMAQMD and Cal/OSHA do have notification requirements for asbestos related work. See Section 13260.

D. Contractor is to submit a Lead-Work Pre-Job Notification to CAL/OSHA as required by 8 CCR 1532.1.
1.7 UNIVERSITY CONTACTS

A. University's Representative: Dave Brooks
   1. Phone: 916-734-0221
   2. Fax: 916-734-7751

B. UCDHS EH&S Representative: Kaila Benton-Vitz
   1. Phone: 916-734-2740
   2. Fax: 916-734-7309

C. University Hazardous Material Consultant: Rick Beall (Entek Consulting Group, Inc.)
   1. Phone: 916-632-6800
   2. Fax: 916-632-6812

PART 2 - PRODUCTS

2.1 MATERIALS

A. Safety Data Sheets (SDS)
   1. The Contractor shall provide SDS for all products used on UCDHS job sites. The
      SDS files shall be located near the Project site entrance at all times the product
      is used or stored onsite.
   2. One complete set of Safety Data Sheets is to be provided to UCDHS EH&S for
      review prior to the start of work. (see 1.41)

B. Encapsulants
   1. It is not anticipated encapsulants will be required for this project. If used, the
      choice of the correct encapsulant for a project is determined by agreement
      between the Contractor and the University's Representative. Two factors to
      consider in the choice are wear life (aim for 20 years) and usage patterns.
      Products shall be applied using a brush, roller or an airless sprayer. The
      Contractor shall follow strict manufacturer's instructions regarding surface
      preparation, ambient air conditions, depth of material penetration, recommended
      thickness of a dry application, and curing time.
      a) For penetrating and lockdown purposes Foster 32-60, Certane 909, or
         equal is recommended.
      b) For bridging purposes Foster 32-32, Certane 2000, or equal is
         recommended.
      c) For high temperature applications, e.g., steam pipes, Foster 84-18,
         Certane 1000, or equal is recommended.
   2. Any proposed equal to the products listed above must meet the following criteria:
      submit product information prior to the start of the Project and must receive
      approval by the University Representative and UCDHS EH&S Representative;
      non-toxic and non-irritating as defined by the Hazardous Substance Control Act;
      sufficiently tinted to provide contrast with the material being coated; and have a
      minimum 60 psi Batelle Standard impact rating.
3. All products shall be rated UL Class A and have a flame resistance/spread rate less than or equal to 25 as designated by the ASTM code E 162. Any exceptions must be pre-approved by UCDHS Fire Prevention Office (916-734-3036).

C. Polyethylene Products

1. Floor and wall sheeting used for lead containments or critical barriers are required to have a minimum thickness of: a) 6-mil (floor) and 4-mil (walls); and, b) meet the following standards -- ASTM E-84, with a flame resistance/spread rate less than or equal to 25 ASTM (E-162).

2. The polyethylene sheeting used for containment or critical barriers shall be frosted or black. Polyethylene bags or sheeting used for waste may be clear.

D. Paint Removers

1. All paint removers shall be pre-approved by UCDHS EH&S. Methylene chloride based paint removers are not permitted on this project.

2. The use of paint removers on the project must strictly comply with manufacturer application instructions and safety warnings.

2.2 EQUIPMENT

A. HEPA/ULPA vacuums and negative air machines must be leak tested on-site by a firm independent of the Contractor, who are trained and qualified to perform the challenge testing of portable HEPA filtered equipment, shall follow the manufacturers recommended test procedure, and shall use the recommended test challenge agent.

B. Tools and equipment shall arrive at the project site free of lead debris and dust.

C. HEPA/ULPA vacuum exteriors must be clean when they arrive on project site. All openings on the vacuum, hoses, and negative air units shall be taped shut when they are brought onto the project site and when they are taken from the project site.

D. All electric tools and equipment shall be connected to a GFCI.

E. Power tools used to prepare surfaces containing lead must be connected to a HEPA/ULPA vacuum.

F. Heat guns with a working temperature less than or equal to 1100° F are permitted.

PART 3 - EXECUTION

3.1 SAFETY

A. In accordance with State and Federal laws, Contractor shall be responsible for conditions of the project site; including the safety of all persons and property during the performance of work. To ensure effective communication in safety matters the Contractor shall participate and conduct the following meetings:

1. A pre-construction safety meeting is required to be held with the University's Representative, University Hazardous Material Consultant, and the UCDHS EH&S Representative prior to the start of the project. The following subjects shall be discussed: Division 13 Specifications; impact to building occupants; waste disposal, and work related safety programs.
2. On the first day of lead related work, the Contractor shall conduct a safety meeting (tailgate) for its employees and subcontractor employees that alert them to the specific hazards of the project. The Contractor must conduct the safety meeting in the primary language of its employees. If needed, more than one primary language presentation must occur. This same initial safety meeting must be provided to all personnel new to the project before they are permitted to start work.

3. On a weekly basis, the Contractor shall conduct a safety meeting with its employees.

3.2 WORK SITE PREPARATION

A. Prior to beginning any on-site work preparation, the Contractor shall walk the project area with the University Hazardous Material Consultant and UCDHS EH&S Representative to discuss site characterization, regulated area set-up, access controls, background samples, security, and safety issues.

B. Post all regulatory notices, permits, sign-in-out roster, at the primary entrance to the project site.

C. The Contractor, in coordination with the University Hazardous Material Consultant and UCDHS EH&S Representative shall ensure all electrical and HVAC equipment servicing the work area is disconnected and locked out. Electrical tools in the work zone must be connected to a GFCI.

D. The Contractor shall seal existing critical barriers, including HVAC openings, windows, vents, open pipes, skylights, ducts, doorways, corridors, and diffusers with double layers of plastic and cardboard or plywood inserts as necessary.

E. The Contractor shall pre-clean fixed objects and interior surfaces prior to establishing containment or critical barriers. The area to be pre-cleaned will be a minimum of 10 feet outside the Controlled area or surrounding structure which ever is closest. The Contractor will pre-clean exposed fixed objects and interior surfaces within the containment.

F. The Contractor shall install approved backflow prevention devices before connecting to the University's domestic water system, if necessary. Contact the University's Representative for a list of approved devices.

G. The Contractor is obligated to coordinate inspection schedules with the University's Representative and the University Hazardous Material Consultant.

H. The Contractor shall establish project site control barriers.

3.3 WORK SITE CONTROL

A. The Contractor shall restrict the work areas to authorized personnel; including, the Contractor's employees, University's Representatives, UCDHS EH&S Representative, University Hazardous Material Consultant and regulatory agency representatives.

B. At regulated project sites, the Contractor shall use caution tape to demarcate the boundary of the work zone and post lead warning signs.

1. The following sign is required by Title 8, CCR 1532.1

DANGER
LEAD WORK AREA
MAY DAMAGE FERTILITY OR THE UNBORN CHILD
CAUSES DAMAGE TO THE CENTRAL NERVOUS SYSTEM
DO NOT EAT, DRINK OR SMOKE IN THIS AREA

C. All unauthorized personnel are to remain outside the regulated area. The Contractor shall call the University's Representative, EH&S Representative or the University Hazardous Material Consultant if unauthorized UCDHS staff or the public enters the containment area.

D. If inclement weather threatens the project site, the Contractor shall take all necessary measures to ensure lead-contaminated debris does not migrate from regulated areas. Steps shall also be taken to prevent water intrusion/water damage to the work site and adjacent areas.

E. If wind speed threatens the project site, the Contractor shall erect a wind barrier or suspend operations until the wind is below 15 mph.

3.4 RECORDKEEPING

A. The Contractor shall maintain the following records at the regulated work area:

1. Site Log (sign-in/sign-out).
3. Personal air sampling results.
4. Area sample results from inside and outside the regulated area.
5. Lead Supervisor (Contractor) and Lead Worker training certificates, respirator fit tests, and medical clearance certificates.
6. Federal, state or local notifications.

B. All Items 1 through 6 shall be submitted with the “As-Built” summary identified in “Project Close-Out”.

C. The University Hazardous Material Consultant shall retain all sample records (wipe, bulk, initial, area (perimeter), and clearance samples). Results are reported on a daily basis to UCDHS EH&S and to the Project Manager. At the end of the project, all sampling records are submitted as a complete package in the project close out to the Project Manager.

3.5 ADMINISTRATIVE CONTROLS

A. Any remediation project performed in high heat environments requires the Contractor to comply with T8 CCR 3395, including providing sufficient breaks to maintain a safe environment for their workers.

3.6 ENGINEERING CONTROLS

A. Negative Pressure Enclosure (NPE)

1. Containment protocols shall follow the ICRA requirements when building materials will be disturbed, or removed creating potential dust release.
2. Mini-containments: The construction of a mini-containment requires a minimum of one layer of 6-mil polyethylene and a HEPA/ULPA vacuum or HEPA filtered negative air unit exhausting from the containment.
3. HEPA vacuumed assisted tools shall be used for drilling, cutting, sawing, or removing lead containing paint from surfaces, unless a paste type stripper product is used.

B. Lead Shielding

1. Where lead shielding is to be removed that are associated with walls, floors, ceilings, doors or windows in areas of radiology/X-Rays the contractor shall install 6-mil plastic on the floor immediately surrounding the wall being removed that contains the lead shielding, extending out at least the height of the wall being removed. If ceilings containing lead shielding are removed, the entire floor area shall be sealed with plastic.

2. The lead shielding shall be removed using manual tools such as screw drivers, razor knives, shears, and pry bars. Power tools, heat guns, cutting torches, and other high temperature generating processes are prohibited due to rapid friction and heat increasing the potential to create lead fumes or dust.

3. Contractor shall use methods to minimize airborne lead to the greatest extent possible (e.g., removing an entire wall instead of removing sheetrock from lead shielding prior to removal).

C. HEPA/ULPA Equipment

1. The Contractor shall ensure all HEPA/ULPA filtration units are leak tested on project site by an independent testing contractor. Each piece of equipment shall be tested in compliance with the ANSI Z9.2 Standard (trapping and retaining 99.97% of all test particles of 0.3 microns). Documentation of testing is to be maintained at the work site. The UCDHS EH&S representative or Hazardous Materials Consultant shall be present to observe the challenge testing of all HEPA systems brought onsite.

2. The Contractor shall HEPA/ULPA vacuum visible debris prior to set-up, during the removal process and at the conclusion of each shift.

3. HEPA/ULPA equipment used to establish negative air pressure within a space must run continuously (24-hours a day) until the project is complete.

4. The Contractor shall ensure make-up air is drawn through an inlet that can be easily sealed in the event of a negative air failure. The inlet sealing method must also be effective when there is a failure in the system after normal work hours.

5. All HEPA/ULPA filters must be disposed as hazardous waste.

6. Any HEPA system that has been removed from the project site and brought back to the project site shall be challenge tested again before being placed in use.

D. Wet Methods

1. Prior to removing LCM/PLCM, the Contractor shall adequately wet the material with water. The waste must remain wet until properly packaged for disposal.

E. Removal Operations

1. If there is lead abatement work, as defined in these requirements, the Contractor must use a CDPH-Certified Lead Supervisor and CDPH-Certified Lead Workers. The Lead Supervisor must be present onsite at all times.

2. Ensure all accumulated debris is completely sealed by the end of the shift. After gross debris is bagged, use wet wipe methods and HEPA/ULPA vacuums to clean the polyethylene sheeting.
F. Infection Control

1. An Infection Control Risk Assessment (ICRA) will be developed for this project by the University’s Representative and approved by the UCDMC Infection Prevention. Depending upon the location of the work and the potential for dust generation that could impact patient care, the ICRA may require more stringent controls than those described under this specification including the requirements for negative pressure work environments. Adequacy of controls may be verified by periodic airborne particle counting, conducted by EH&S or a designee. Contractor understands that any operations generating excess particles in uncontrolled locations will cause Contractor to modify site controls. Contractor is responsible for maintaining controls to avoid pollution of patient care spaces.

3.7 WORKER PROTECTION

A. The following protective measures are required for lead-related work associated with this project. These measures are not intended to be all-inclusive:

1. Employee Training/Supervision
   a. The Contractor shall provide information to its employees about lead and other hazards per the Hazard Communication standard (8 CCR, 5194) and other Cal/OSHA standards (e.g., asbestos, fall protection, etc.) as appropriate for the project.
   b. All contractor and subcontractor personnel are to be trained to the level of their project assignment in accordance with 8 CCR 1532.1, which at a minimum will require lead awareness training (1-2 hours in length).

2. Respiratory Protection
   a. The Contractor shall provide respiratory protection to all employees where there is the potential for exposure to lead dust at or above the permissible exposure limit per Title 8 5144 Respiratory Protection.
   b. The Contractor’s employees who wear a respirator must have passed a fit test within the previous 12 months to perform contract work at the University.

3. Protective Clothing
   a. The Contractor shall provide workers with sufficient sets of protective clothing. Tyvek™, Kleenguard™ or equivalent, coveralls (with hood and feet protection) or equal are acceptable. The Contractor shall also provide coveralls to qualified UCDMC personnel, University Hazardous Material Consultant, State and local officials.
   b. Note that work in sterile areas may require multiple sets of clothing or staging of additional protective clothing to ensure sanitary conditions are maintained.
   c. The Contractor shall provide rubber, latex or Nitrile gloves, rubber boots, eye protection, earplugs and hard hats as needed per the 8 CCR, Hazard Communication and Personal Protective Equipment standards.

4. Medical Surveillance
   a. As required by 8 CCR 1532.1, the Contractor shall establish a medical surveillance program for all employees performing lead work if work is expected to exceed the Action Level for more than 30 days per year. In addition, all personnel required to wear a respirator shall have an medical evaluation to assure they are capable of wearing a respirator per T8 CCR 5144.
   b. The Contractor shall demonstrate all project personnel are participating in the medical surveillance program with evidence supported in the pre-job submittal.
3.8 PERSONAL HYGIENE

A. The Contractor shall require that no employee be allowed to apply cosmetics, or consume food, tobacco products, or beverages in the regulated work area.

B. The Contractor shall establish a location outside the work area, which shall be designated for employee eating and drinking. Employees must utilize the on-site decontamination facilities for clean-up prior to entering the designated eating/drinking location. The eating area shall be kept clean of dust on all horizontal surfaces. Cleaning stations shall include clean water, soap, and towels. All workers shall clean face, hands and lower arms before leaving the work area for break periods, and at the end of the work shift.

3.9 AIR MONITORING PROGRAM

A. Personal Air Samples - Contractor Responsibility

1. The Contractor shall presume remediation activities will exceed the PEL and conduct initial and daily exposure assessments in accordance with T8 1532.1.

2. Exposure assessments are to be conducted in accordance with 8 CCR 1532.1(d).

B. Area Sampling

1. Daily Perimeter Monitoring – University Hazardous Material Consultant Responsibilities
   a. The University Hazardous Material Consultant is responsible for monitoring the perimeter of the work zone. Air samples that exceed 30 ug/m³ per 8 hr. TWA require the University Hazardous Material Consultant to halt work and notify the UCDHS EH&S Representative. Work may resume after the Contractor has identified and corrected the work practice that led to the high airborne lead levels.

2. Daily Monitoring – University Hazardous Material Consultant Responsibilities
   a. The University Hazardous Material Consultant is responsible for monitoring air quality within the regulated area, including the clean room. Any sample at or above 30 µg/M³ TWA in the clean room requires a cessation of work until the area is cleaned and the cause of the problem has been determined and solved. The UCDHS EH&S Representative is to be notified immediately of any such actions. The Contractor shall thoroughly clean the spaces using the HEPA vacuum and wet wiping techniques. Air samples in the work zone that exceed the protection level of a respirator require a cessation of activity. The Contractor's competent person and the University Hazardous Material Consultant shall review work practices with the UCDHS EH&S.

3.10 SPECIFIC WORK PROTOCOLS

A. Specific work protocols, cited below, provide minimum guidance for the performance of site work.

1. Initial Site Clean-Up
   a. Pre-cleaning is required for this project, where dust and debris will impact setting up the work place control measures.
   b. LBP/LCM contaminated chips or debris, etc. generated during the project shall be collected while workers are wearing proper respirators and
disposable coveralls, and using HEPA vacuums, wet methods, polyethylene bags, lead warning labels and proper disposal protocols.

2. Interim Controls (In-Place-Management)
   a. This is a control measure to reduce or eliminate lead exposure for less than 20 years. It is not considered abatement. Several strategies are used to control potential exposure to LCM left in place; including, dust removal, paint stabilization, treatment of impact/friction surfaces, and soil coverings. No Interim Controls for lead are included in this project.
   b. Dry blasting LCM is not permitted except by special circumstances pre-approved by the UCDHS EH&S Representative.
   c. Water blasting LCM surfaces will not be allowed.

3. Abatement
   a. Lead abatement is not planned for this project. Abatement is meant to permanently control LCM products for a period of time greater than 20 years.
   b. The renovation project may impact lead in building components, but any disturbance to lead in paint must follow the Lead in Construction requirements of 8 CCR 1532.1.
   c. If the contractor needs to remove paint from surfaces, there are many options to consider including use of paint removal paste (such as Peel Away or equivalent), wet sanding, and HEPA equipped shrouded tools when disturbing LCM surfaces.
   d. Dry blasting LCM is not permitted except by special circumstances pre-approved by the UCDHS EH&S Representative.
   e. Water blasting LCM surfaces will not be allowed.

3.11 INSPECTIONS

A. Inspection Responsibilities - Contractor
   1. Prior to beginning any lead-related work, the Contractor’s lead supervisor shall inspect the regulated work areas for any building damage, hazardous conditions and/or irregularities that may contribute to an unsafe work environment. Any condition that poses a hazard or potential hazard to the Contractor’s employees or the University’s employees, patients and visitors must be immediately reported to the University’s Representative.
   2. The Contractor is responsible for notifying and allowing sufficient time for the University Hazardous Material Consultant to conduct inspections at all phases of the project.
   3. The Contractor shall establish emergency response protocols for a manometer alarm sounding after they have left the project site. Under no circumstances shall the Contractor shut off negative air machines, unless the project has received final clearance. Dust control requirements under the ICRA Permit will require the work space to be placed under negative pressure for the duration of the demolition phase and new construction phase.
   4. All waste shall be characterized and separated by the Contractor. Wastes will be sampled individually as directed by the University Hazardous Materials Consultant to determine levels of lead before containerizing for shipment.

B. Inspection Responsibilities – University Hazardous Material Consultant
   1. The University Hazardous Material Consultant shall walk the project site with the Contractor and the UCDHS EH&S Representative to review scope of work, pre-cleaning operations and any safety or security issues. The University Hazardous Material Consultant may attend the Contractor’s safety meetings.
2. If minor lead related work requires removal of paint from surfaces using a paste, or work practices using HEPA filtered equipment, the hazard control measures shall be evaluated by the University Hazardous Material Consultant or University EH&S.

3. Prior to lead related work activities beginning, the University Hazardous Material Consultant shall match on-site personnel with lead training certificates, fit tests and medical exam records. Workers without on-site documentation shall not be allowed in the regulated area.

4. The University Hazardous Material Consultant is responsible for:
   a. Reviewing all sampling data and all waste stream profiles.
   b. Alerting the UCDHS EH&S Representative of any sample result exceeding 30 μg/m³ per 8 hr. TWA.
   c. Review Contractor's performance and non-compliance report to the Project Manager.

5. The University Hazardous Material Consultant shall file a report of activities with the University's Representative and the UCDHS EH&S Representative on an agreed upon schedule.

6. After abatement or interim control activities are complete, the University Hazardous Material Consultant shall verify completeness of all visible debris is removed.

7. University Hazardous Material Consultant shall review contractor's waste characterization for the most efficient disposal for the University; all recommended disposal processes must be reviewed and approved by the UCDHS EH&S Representative.

3.12 ENCAPSULATION, FINAL CLEAN-UP AND RESTORATION

A. Encapsulation

1. Encapsulation for lead painted components is not anticipated for this project.

B. Final Clean-Up

1. Contractor shall clean entire project area of dust from all surfaces within the construction work area.

C. Restoration

1. Fixtures, equipment or objects relocated to storage areas designated by the University's Representative shall be restored to their exact position. The Contractor assumes full financial responsibility for damage to these objects.

3.13 WASTE DISPOSAL

A. Packaging Lead Waste

1. All lead containing waste material must be packaged and labeled in accordance with U.S. DOT, DTSC and EPA requirements.

B. Storing Lead Waste

1. At the end of each shift, all lead waste shall be stored in a lockable container or shipped off site. Accumulated waste shall not be allowed to remain in the regulated work area overnight. No container shall be allowed to remain at the project site for greater than 90 continuous days from date the first waste container was generated.

C. Uniform Hazardous Waste Manifest Procedures

1. The Contractor or transporter is responsible for providing appropriate Uniform Hazardous Waste Manifests for the transport of hazardous waste materials. Only
authorized EH&S personnel can sign on behalf of the UC Davis Medical Center (generator).

D. Transporting Lead Waste to Class 1 Landfill
1. A DTSC registered waste transporter, hired by the Contractor, is responsible for transporting hazardous lead waste from the Medical Center to (Chemical Waste Management, 35251 Old Skyline Road, Kettleman City, CA 93239), an EPA permitted disposal facility. Under certain conditions, UCDHS EH&S will permit hazardous lead waste to be transported to an alternative facility.
2. The transporter shall make pick-ups during normal Working hours - 8:00 AM to 5:00 PM, Monday through Friday. The Contractor must comply with DOT label requirements for their vehicles.
3. The Contractor must make shipments of lead waste containing less than 1,000 mg/kg lead but greater than 350 mg/kg of lead to a Class 1 landfill. This shipment does not require a registered waste hauler.

E. Disposal
1. The selection of a Treatment, Storage and Disposal Facility as an alternative to a landfill for disposal of lead waste must be reviewed and approved by the EH&S representative prior to arranging for the shipment of the waste.
2. The Contractor shall provide waste documents from the Waste Disposal site as verification of the weight and proper disposal site, to the UCDHS EH&S Representative within 15 days of each container disposal.
3. Lead waste that has been contaminated with another hazardous waste (e.g. solvents) must be tested and disposed according to all applicable standards.
4. All lead waste will be sampled for Characterization before determination of Hazardous or Non-Hazardous material is made. Sequence of testing is as follows:
   a. A TTLC result of ≥1,000 mg/kg is considered a hazardous waste.
   b. TTLC with a result of ≥50 mg/kg of lead must be retested using STLC method.
   c. A STLC result of ≥5.0 mg/l must be retested using TCLP.
   d. A TCLP result of ≥5.0 mg/l deems the waste Federal RCRA.
   e. A STLC of ≥5 mg/l is categorized as State Hazardous Waste (Class 1).
   f. A TTLC with a result of >350 mg/kg but <5.0 mg/l (STLC and TCLP) must go to landfill permitted to accept this level of lead although it is not hazardous. (See Item 6 below)
5. Contractor shall provide a waste stream report to the University Hazardous Material Consultant identifying the number of containers and an explanation of how the samples were taken (composite or individual container sampling). A waste stream profile must be conducted on each unique waste stream. Confirmation will be provided by the Consultant, indicating all waste streams have been sampled per project specifications.
6. All waste with total lead >350 ppm (mg/kg) disposed of in California, must be disposed of at a permitted Class 1 Hazardous waste landfill, or at other landfills that have specific permits to accept these wastes. However, the wastes are not classed as hazardous wastes unless for a reason other than lead content. The California hazardous waste threshold for total lead is ≥1,000 mg/kg and the soluble threshold concentration (STLC) for lead is ≥5 mg/l.

F. Recordkeeping
1. The Contractor shall provide the UCDHS Project Manager with copies of all waste disposal documents.

G. Fees
1. The Contractor is responsible for all fees and charges related to lead waste transport and disposal operations; including, waste steam profiles. Refer to SW-846-1311 (TCLP) and CCR, Title 22 Section 66261 (STLC) for waste stream identification requirements.

H. Non-Hazardous Waste Manifest

1. The UCDHS EH&S Representative or Hazardous Materials Consultant (if authorization is provided by UCDHS) is responsible for reviewing and signing non-hazardous waste manifests. Prior to the Representative signing the manifest, the University Hazardous Material Consultant shall inspect the load and confirm its non-hazardous status.

I. Recycled Metals

1. Recycling ferrous or non-ferrous metals with adhered lead paint is encouraged by the UCDHS. The UCDHS expects that lead shielding will be recycled. This section defines “Hazardous Waste” for the purpose of defining waste stream as material that is placed in a land fill. Employee protection regulations remain the same during disturbance of lead. The Contractor is required to remove all loose and flaking paint. The Contractor is responsible for removing all other hazardous material that is unacceptable by the recycling firm. The Contractor is required to recycle where possible. The contractor will obtain a letter from the recycler acknowledging that the recycler is aware of the lead paint and has an Injury Illness Prevention Program (IIPP) that addresses the handling of this material that meets OSHA and EPA regulations. There is no UCDHS requirement for testing (TTLC, STLC, or TCLP) the recycle material stream.

3.14 CLEARANCE PROTOCOL

A. Abatement and Interim Control Projects

1. Lead abatement is not planned for this project; therefore, clearance wipe sampling is not currently planned. If however, there is lead abatement due to an identified lead hazard, the following will be conducted:

2. Prior to any clearance sampling, the regulated areas shall be visually inspected by the University Hazardous Material Consultant for the presence of LBP chips, visible settled dust or debris. Final clearance sampling shall not take place until the area has successfully passed this visual clearance. The Consultant shall follow the U.S. Housing and Urban Development (HUD) clearance wipe sampling protocol, which includes wiping one square foot of the surface being tested using an “S” pattern with an approved commercial lead sampling wipe. Clearance wipe sampling shall be conducted in locations most likely to be contaminated.

2. The University Hazardous Material Consultant and University’s Representative following HUD guidelines and CDPH Title 17 requirements, shall select the total number of clearance samples for each job site and shall use the Title 17 criteria for clearance purposes.

3.15 PROJECT CLOSE OUT

A. Before the final certificate for payment is issued to the Contractor the following information shall be provided to the University’s Representative:

1. Using Exhibit 25 Lead Remediation-As-Built Summary (located in the Exhibits section of the Contract Documents) provide “As-Built” summary to include:
Project No. M030667
Hospital Seismic Upgrade – Decommission North/South Wing

a. Contractor’s name, addresses, CSLB certification number, DOSH registration number, and tax identification number.
b. Name of hazardous transporter, address, phone number and registration number.
c. ELAP laboratory name(s), addresses, and phone number(s) used to perform AA (flame), TCLP, TTLC or STLC analysis.
d. Building name and campus address.
e. Project name and contract number.
f. Describe scope of Work; Interim Controls or Abatement and location (room number[s]); provide drawings detailing the areas in which lead work that were accomplished.
g. Provide an inventory of the LCM/PLCM removed from the project site. Include: building system, quantity, note whether the project was Abatement or Interim Controls, the percentage of the total lead job for each building system type and cost.
h. Total dollar amount paid by the University for lead-related work including invoice date(s) and date(s) payment received.
i. Number of employees who worked on the project
j. Date on-site work began
k. Date on-site work was completed
l. Work methods
m. Did the University provide specification (answer yes or no).
n. Name, address, phone number and EPA registration number of waste disposal site.
o. Note that all copies of waste documents from the Waste Disposal site for hazardous material must be received by the University’s Representative as part of this section.
p. The Contractor shall provide copies of all laboratory reports lead work protocols, and disposal documents requested by the University’s Representative.
q. All documents relating to actual employees used for remediation purposes (see Section 3.4, A).

END OF SECTION 02 83 00
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: The Work of this Section includes all material and installation of cast-in-place Concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes as shown and detailed on the Drawings and specified herein.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.3 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mix water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Design and engineering of formwork are Contractor's responsibility.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

E. Welding Certificates: Copies of certificates for welding procedures and personnel.

F. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

G. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Cementitious materials and aggregates.
2. Form materials and form-release agents.
3. Steel reinforcement and reinforcement accessories.
4. Admixtures.
5. Curing materials.
6. Floor and slab treatments.
8. Adhesives.
9. Vapor retarders.
10. Epoxy joint filler.
12. Repair materials.

1.4 QUALITY ASSURANCE

A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for formwork and shoring and reshoring installations that are similar to those indicated for this Project in material, design, and extent.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code-Reinforcing Steel."

F. ACI Publications: Comply with the following, unless more stringent provisions are indicated:

1. ACI 01, "Specification for Structural Concrete."

2. ACI 17, "Specifications for Tolerances for Concrete Construction and Materials."
G. Before submitting design mixes, review concrete mix design 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:

1. Contractor’s superintendent.
2. Independent testing agency responsible for concrete design mixes.
4. Concrete subcontractor.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Avoid damaging coatings on steel reinforcement.
2. Repair damaged epoxy coatings on steel reinforcement according to ASTM D 3963/D 3963M.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
   a. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

E. Chamfer Strips: Wood, metal, PVC, or rubber strips, ¾” x ¾”, minimum.

F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.


2.2 STEEL REINFORCEMENT
A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed.
B. Plain-Steel Wire: ASTM A 82, as drawn.
C. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.

B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
C. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain-steel bars.
D. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 755M.
E. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I/II.
B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:

1. Class: Moderate weathering region, but not less than 3M.
C. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride. Use no mixtures not included in the mix design.

2.6 VAPOR RETARDERS

A. Vapor Retarder: ASTM E 1745, Class C, of one of the following materials; or polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick:
1. Nonwoven, polyester-reinforced, polyethylene coated sheet; 10 mils (0.25 mm) thick.

2. Three-ply, nylon or polyester-cord-reinforced, laminated, high-density polyethylene sheet; 7.8 mils (0.18 mm) thick.

B. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100% passing a No. 4 sieve and 10 to 30% passing a No. 100 sieve; meeting deleterious substance limits of ASTM C 33 for fine aggregates.

C. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100% passing a 1-½" sieve and 0 to 5% passing a No. 8 sieve.

2.7 FLOOR AND SLAB TREATMENTS

A. Penetrating Liquid Floor Treatment: Chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.

2.8 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Clear, Solvent-Borne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

C. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

D. Curing compound and areas to receive compound must be approved by University's Representative prior to placement.

2.9 RELATED MATERIALS


B. Epoxy Joint Filler: Two-component, semirigid, 100% solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, 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 and grade to suit requirements, and as follows:

1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.0217-inch-thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

2.10 REPAIR MATERIALS
A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from $\frac{3}{4}^\prime$ and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, $\frac{3}{8}$ to $\frac{1}{4}^\prime$ 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.

2.11 CONCRETE MIXES

A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.

2. Proportion lightweight structural concrete according to ACI 211.2 and ACI 301.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.


1. Maximum Slump: 5” (125 mm).

D. Slab-on-Grade: Proportion normal-weight concrete mix Compressive Strength (28 Days): 4000 psi (20.7 MPa).

1. Maximum Slump: 5” (125 mm).


1. Maximum Slump: 5” (125 mm).

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI’s “Manual of Standard Practice.”

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.

1. When air temperature is between 85 and 90°F, reduce mixing and delivery time from 1-½ hours to 75 minutes; when air temperature is above 90°F, reduce mixing and delivery time to 60 minutes.
PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
   1. Class A, ¼”.
   2. Class B, ¼”.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, 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. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 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. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor bolts, accurately located, to elevations required.

2. Install reglets to receive top edge of foundation sheet 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.

3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: 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°F (10°C) for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.

B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:

1. 28-day design compressive strength.

C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by University’s Representative.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M), ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.

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.

3.5 VAPOR RETARDERS

A. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer’s written instructions.

B. Fine-Graded Granular Material: Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus ¾” (19 mm).
C. Granular Fill: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus ¾" (19 mm).

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Shop-or field-weld reinforcement according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by University's Representative.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-½" into concrete.

3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of ¼”. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut ¼”-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than ½” or more than 1” below finished concrete surface where joint sealants are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.

1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by University's Representative.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.

D. Deposit concrete in forms in horizontal layers no deeper than 24” and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6” into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.


3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F and not more than 80°F at point of placement.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

G. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90°F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES
A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding ¼” in height.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.

2. Do not apply rubbed finish to smooth-formed finish.

C. Rubbed Finish: Apply the following to smooth-formed finished concrete:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes.

1. Apply scratch finish to surfaces indicated on drawings and to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces indicated and to floor and slab 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.

2. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:
   a. Specified overall values of flatness, $F(F)$ 45; and levelness, $F(L)$ 35; with minimum local values of flatness, $F(F)$ 30; and levelness, $F(L)$ 24.

E. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.

F. Broom Finish: Apply a medium broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with University's Representative before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.12 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:
D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12" lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12" and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least two (2) months. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semi rigid epoxy joint filler full depth in saw-cut joints and at least 2" deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.
3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by University's Representative. Remove and replace concrete that cannot be repaired and patched to University's Representative's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on 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 ½" in any dimension in solid concrete but not less than 1" in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by University's Representative.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

E. Perform structural repairs of concrete, subject to University's Representative's approval, using epoxy adhesive and patching mortar.
F. Repair materials and installation not specified above may be used, subject to University’s Representative’s approval.

3.15 FIELD QUALITY CONTROL

A. University’s Testing Agency: University will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

2. Testing Frequency: Obtain at least one composite sample for each 400 cu. yd. or fraction thereof of each concrete mix placed each day.

   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.

4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.

5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.

   a. Cast and field cure one set of four standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.

   a. Test two field-cured specimens at 7 days and two at 28 days.

   b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.

C. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
D. Test results shall be reported in writing to University's Representative, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by University's Representative but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by University's Representative. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by University's Representative.

END OF SECTION 03 30 00
DIVISION 04
MASONRY
SECTION 04 22 00
UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work of this Section shall include all material and installation necessary to provide unit masonry assemblies as shown and detailed on the drawings:

1. Concrete masonry units.
2. Mortar and grout.
3. Reinforcing steel.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Miscellaneous masonry accessories.

B. Related Sections include the following:

1. Division 7 – Thermal and Moisture Protection

C. Products furnished, but not installed, under this Section include the following:

1. Dovetail slots for masonry anchors, installed under Section 03 30 00 – Cast-in-Place Concrete.
2. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Division 5, Section 05 12 00 – Structural Steel.

1.2 DEFINITIONS

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

1.3 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops the following net-area compressive strengths (f'm) at 28 days. Determine compressive strength of masonry from net-area compressive strengths of masonry units and mortar types according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

B. Provide unit masonry that develops the following net-area compressive strengths (f'm) at 28 days. Determine compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

1. For Concrete Unit Masonry: As indicated.

1.4 SUBMITTALS
A. Product Data: For each different masonry unit, accessory, and other manufactured product specified.

B. Shop Drawings: Show fabrication and installation details for the following:
   1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
   2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection: For the following:
   1. Unit masonry Samples in small-scale form showing the full range of colors and textures available for each different exposed masonry unit required.
   2. Colored mortar Samples showing the full range of colors available.

D. Samples for Verification: For the following:
   1. Full-size units for each different exposed masonry unit required, showing the full range of exposed colors, textures, and dimensions to be expected in the completed construction.
   2. Colored mortar Samples for each color required, showing the full range of colors expected in the finished construction. Make samples using the same sand and mortar ingredients to be used on Project. [Label Samples to indicate types and amounts of pigments used.]

E. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
   1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents, unless such deviations are specifically brought to the attention of the University's Representative and approved in writing.

F. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

G. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
   1. Each type of masonry unit required.
      a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.
      b. Include test results, measurements, and calculations establishing net-area compressive strength of masonry units.
   2. Mortar complying with property requirements of ASTM C 270.
3. Grout mixes complying with compressive strength requirements of ASTM C 476. Include description of type and proportions of grout ingredients.

H. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Each type of masonry unit required.
   a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.
   b. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.

2. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.

3. Each combination of masonry unit type and mortar type. Include statement of net-area compressive strength of masonry units, mortar type, and net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

4. Each material and grade indicated for reinforcing bars.

5. Each type and size of joint reinforcement.

6. Each type and size of anchor, tie, and metal accessory.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1093 to conduct the testing indicated, as documented according to ASTM E 548.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Preconstruction Testing Service: University will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by the University. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

1. Concrete Masonry Unit Test: For each concrete masonry unit indicated, per ASTM C 140.

2. Prism Test: For each type of wall construction indicated, per ASTM C 1314.

3. Mortar Test: For mortar properties per ASTM C 270.

E. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

F. Sample Panels: Before installing unit masonry, build sample panels, using materials indicated for the completed Work, to verify selections made under sample Submittals and to demonstrate aesthetic effects. Build sample panels for each type of exposed unit masonry assembly in sizes approximately 48" long x 48" high by full thickness.

1. Locate panels in the locations indicated or, if not indicated, as directed by University's Representative.

2. Clean exposed faces of panels with masonry cleaner indicated.

3. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.

4. Protect approved sample panels from the elements with weather-resistant membrane.

5. Maintain sample panels during construction in an undisturbed condition as a standard for judging the completed Work.

6. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by University's Representative in writing.

   a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels, unless such deviations are specifically approved by University's Representative in writing.

7. Demolish and remove sample panels when directed.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 "Coordination"

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.

   1. Protect Type I concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.

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 designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT 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” down both sides and hold cover securely in place.

2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24” down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread 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.

D. 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 ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40°F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.

1. When ambient temperature exceeds 100°F or 90°F with a wind velocity greater than 8 mph do not spread mortar beds more than 48” ahead of masonry. Set masonry units within one minute of spreading mortar.
PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. General: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.

2. Provide bullnose units for outside corners, unless otherwise indicated.

3. Provide square-edged units for outside corners, unless indicated as bullnose.

B. Concrete Masonry Units: ASTM C 90 and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.

2. Provide Type II, nonmoisture-controlled units.

3. Size (Width): Manufactured to the following dimensions:
   a. 4" nominal; 3-⅜" actual.
   b. 6" nominal; 5-⅜" actual.
   c. 8" nominal; 7-⅜" actual.
   d. 10" nominal; 9-⅜" actual.
   e. 12" nominal; 11-⅜" actual.

4. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
   a. Where units are to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.
   b. Where units are to be left exposed, provide color and texture matching the range represented by University's Representative's sample.

2.2 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, 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 C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.

D. Mortar Cement: ASTM C 1329.

E. Masonry Cement: ASTM C 91.
1. For pigmented mortar, use a colored cement formulation as required to produce the color indicated or, if not indicated, as selected from manufacturer's standard formulations.
   a. Pigments shall not exceed 10% of portland cement by weight for mineral oxides nor 2% for carbon black.
   b. Pigments shall not exceed 5% of mortar cement by weight for mineral oxides nor 1% for carbon black.

F. Aggregate for Mortar: ASTM C 144; except for joints less than ¼” thick, use aggregate graded with 100% passing the No. 16 sieve.
   1. White-Mortar Aggregates: Natural white sand or ground white stone.
   2. Colored-Mortar Aggregates: Natural-colored sand or ground marble, granite, or other ground stone; of color necessary to produce required mortar color.


H. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

I. Refractory Mortar Mix: Ground fireclay or non-water-soluble, calcium aluminate, refractory mortar; complying with ASTM C 199, medium duty; or an equivalent product acceptable to authorities having jurisdiction.

J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by the manufacturer for use in masonry mortar of composition indicated.

K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.

L. Water: Potable.

2.3 REINFORCING STEEL

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M; ASTM A 616/A 616M, including Supplement 1; or ASTM A 617/A 617M, Grade 60

B. Epoxy-Coated Reinforcing Steel: ASTM A 615/A 615M, Grade 60; epoxy coated to comply with ASTM A 775/A 775M.

2.4 MASONRY JOINT REINFORCEMENT

A. General: ASTM A 951 and as follows:
   1. Mill galvanized, carbon-steel wire for interior walls.
   3. Hot-dip galvanized, carbon-steel wire for both interior and exterior walls.

5. Stainless-steel wire for exterior walls.

6. Wire Size for Side Rods: W1.7 or 0.148” diameter.

7. Provide in lengths of not less than 10’, with prefabricated corner and tee units where indicated.

2.5 TIES AND ANCHORS, GENERAL

A. General: Provide ties and anchors, specified in subsequent articles, made from materials that comply with this Article, unless otherwise indicated.

B. Mill Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 641, Class 1 coating.


D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 , commercial-quality, steel sheet zinc coated by hot-dip process on continuous lines before fabrication.

E. Steel Sheet, Galvanized after Fabrication: ASTM A 366/A 366M cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153.

F. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.6 BENT WIRE TIES

A. General: Rectangular units with closed ends and not less than 4” wide. Z-shaped ties with ends bent 90° to provide hooks not less than 2” long may be used for masonry constructed from solid units or hollow units laid with cells horizontal.

1. Where coursing between wythes does not align, use adjustable ties composed of 2 parts; 1 with pintles, the other with eyes; with maximum misalignment of 1-¼”.

B. Wire: Fabricate from ¼” diameter, hot-dip galvanized steel

2.7 ANCHORS FOR CONNECTING TO CONCRETE

A. General: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section: Dovetail anchor section formed from 0.0528” thick, steel sheet, galvanized after fabrication.

2. Tie Section: Triangular-shaped wire tie, sized to extend within 1” of masonry face, made from 0.1875” (4.8-mm) diameter, hot-dip galvanized steel.

2.8 RIGID ANCHORS

A. General: Fabricate from steel bars as follows:

1. 1-½” wide x ¼” thick x 24” long, with ends turned up 2” or with cross pins.
2.9 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron inserts of type and size indicated.

B. Dovetail Slots: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.0336 inch galvanized steel sheet.

C. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade, with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:
   1. Headed bolts.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35%; of width and thickness indicated; formulated from [neoprene] [urethane] [or] [PVC].

B. Preformed Control-Joint Gaskets: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
   2. PVC: ASTM D 2287, Type PVC-65406.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, ¾” OD x 4” long.

E. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, ¾” by 1-½ x 3-½”.

F. Wicking Material: Cotton or polyester rope, ¼ to ½” in diameter, in length required to produce 2” exposure on exterior and 18” in cavity between wythes.

G. Plastic Weep Hole/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, designed to fill head joint with outside face held back ½” from exterior face of masonry, in color selected from manufacturer's standard.

H. Vinyl Weep Hole/Vent: One-piece, offset, T-shaped units made from flexible, injection-molded PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color approved by University's Representative to match that of mortar.

I. Cavity Drainage Material: ¾” thick, free-draining mesh; made from polyethylene strands and shaped to avoid being clogged by mortar droppings.

J. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142” steel wire, hot-dip galvanized after fabrication.
1. Provide units with either two loops or four loops as needed for number of bars indicated.

2.11 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. Add cold-weather admixture (if used) at the same rate for all mortar, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the 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 C 270, Proportion Specification.


1. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.

2. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement, mortar cement, and lime.

3. For masonry below grade, in contact with earth, and where indicated, use Type M.

4. For reinforced masonry and where indicated, use Type S.

5. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

6. For interior non-load-bearing partitions, Type O may be used instead of Type N.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.

2. Provide grout with a slump of 8 to 11” as measured according to ASTM C 143.

F. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's directions.

2.12 SOURCE QUALITY CONTROL

A. University will engage a qualified independent testing agency to perform source quality-control testing indicated below:
1. Payment for these services will be made by University.

2. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

B. Brick Tests: For each type and grade of brick indicated, units will be tested according to ASTM C 67.

C. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Verify that foundations are within tolerances specified.

2. Verify that reinforcing dowels are properly placed.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this Section and in other Sections of the Specifications.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.

D. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
G.  Wetting of Brick:  Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67.  Allow units to absorb water so they are damp but not wet at the time of laying.

3.3 CONSTRUCTION TOLERANCES

A.  Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:

1.  For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than ¼" in 20 feet, nor ½" maximum.

2.  For vertical alignment of exposed head joints, do not vary from plumb by more than ¼" in 10 feet, nor ½" maximum.

3.  For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than ¼" in 20 feet, nor ½" maximum.

4.  For exposed bed joints, do not vary from thickness indicated by more than plus or minus ¼", with a maximum thickness limited to ½".  Do not vary from bed-joint thickness of adjacent courses by more than ½".

5.  For exposed head joints, do not vary from thickness indicated by more than plus or minus ⅛".  Do not vary from adjacent bed-joint and head-joint thicknesses by more than ⅛".

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:  Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4" horizontal face dimensions at corners or jambs.

1.  One-half running bond with vertical joint in each course centered on units in courses above and below.

2.  Stack bond.

3.  One-third running bond.

4.  As indicated on Drawings.

C.  Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2".  Bond and interlock each course of each wythe at corners.  Do not use units with less than nominal 4" horizontal face dimensions at corners or jambs.

D.  Stopping and Resuming Work:  In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth.  Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.
E. **Built-in Work:** As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

F. **Fill space between hollow-metal frames and masonry solidly with mortar, unless otherwise indicated.**

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

H. Fill cores in hollow concrete masonry units with grout 24” (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. **Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.**
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
   3. At fire-rated partitions, install firestopping in joint between top of partition and underside of structure above.

### 3.5 MORTAR BEDDING AND JOINTING

**A. Lay hollow masonry units as follows:**
   1. With full mortar coverage on horizontal and vertical face shells.
   2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
   3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.

**B. Lay solid brick-size 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.**
   1. At cavity walls, bevel beds away from cavity, to minimize mortar protrusions into cavity. As work progresses, trowel mortar fins protruding into cavity flat against the cavity face of the brick.

**C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.**
   1. For glazed masonry units, use a nonmetallic jointer ¾” (19 mm) or more in width.

**D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.**

### 3.6 MASONRY JOINT REINFORCEMENT
A. General: Provide continuous masonry joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of ¾" on exterior side of walls, ½" elsewhere. Lap reinforcement a minimum of 6”.

1. Space reinforcement not more than 16” o.c.
2. Space reinforcement not more than 8” o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8” above and below wall openings and extending 12” beyond openings.
   a. Reinforcement above is in addition to continuous reinforcement.

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.

1. Construct formwork to conform to shape, line, and dimensions shown. Make it sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements of ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.

1. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.8 FIELD QUALITY CONTROL

A. University will engage a qualified independent testing agency to perform field quality-control testing indicated below.

1. Payment for these services will be made by University.
2. Retesting of materials failing to meet specified requirements shall be done at Contractor’s expense.

B. Testing Frequency: Tests and Evaluations listed in this Article will be performed during construction for each 5000 sq. ft. of wall area or portion thereof.
C. Mortar properties will be tested per ASTM C 780.

D. Grout will be sampled and tested for compressive strength per ASTM C 1019.

E. Brick Tests: For each type and grade of brick indicated, units will be tested according to ASTM C 67.

F. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

G. Prism-Test Method: For each type of wall construction indicated, masonry prisms will be tested per ASTM C 1314, and as follows:
   1. Prepare 1 set of prisms for testing at 7 days and 1 set for testing at 28 days.

3.9 PARGING

A. Parge predampened masonry walls, where indicated, with Type S or Type N mortar applied in 2 uniform coats to a total thickness of ¾”. Scarify first pargc coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of ¼” per foot. Form a wash at top of parginc and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect the parging until cured.

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.

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 University's Representative'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, polyethylene film, or waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.

5. Clean brick by the bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20, using job-mixed detergent solution.

6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.

8. Clean limestone units to comply with recommendations in the Indiana Limestone Institute of America's "Indiana Limestone Handbook."

3.11 MASONRY WASTE DISPOSAL

A. Recycling: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove all excess masonry waste and other masonry waste, and legally dispose of off University's property.

END OF SECTION 04 22 00
DIVISION 05
METALS
SECTION 05 12 00
STRUCTURAL STEEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work under this Section shall include all materials and installation necessary to provide Structural Steel as shown and detailed on the Drawings and specified herein.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 9 - PAINTING for surface preparation and priming requirements.

1.2 SUBMITTALS

A. Product Data for each type of product specified.

B. Shop Drawings detailing fabrication of structural steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.

4. Include Shop Drawings signed and sealed by a qualified professional engineer responsible for their preparation.

C. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.

1. Structural steel, including chemical and physical properties.

2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.

3. Direct-tension indicators.

4. Shear stud connectors.

5. Shop primers.


1.3 QUALITY ASSURANCE

A. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:

1. Category: Category II, complex steel building structures.
B. Comply with applicable provisions of the following specifications and documents:


2. AISC's "Load and Resistance Factor Design (LFRD) Specification for Structural Steel Buildings."


5. AISC's "Seismic Provisions for Structural Steel Buildings."

6. ASTM A 6 (ASTM A 6M) "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."


C. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the 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 projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.

D. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code-Steel."

1. Present evidence that each welder has satisfactorily passed AWS qualification tests and has current welding certificates for welding processes involved and, if pertinent, has undergone recertification.

2. Provide welding procedures prior to commencing work.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.

2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel Shapes, Plates, and Bars: As follows:

B. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B.

C. Hot-Formed Structural Steel Tubing: ASTM A 500, Grade B.

D. Steel Pipe: ASTM A 53, Type E or S, Grade B.
   1. Weight Class: Standard.
   2. Finish: Black.


G. Shear Connectors: ASTM A 108, Grade 1015 through 1020, headed-stud type, cold-finished carbon steel, AWS D1.1, Type B.

H. Anchor Rods, Bolts, Nuts, and Washers: As follows:
   4. Headed Bolts: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); carbon-steel, hex-head bolts; and carbon-steel nuts.
   5. Headed Bolts: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.
   6. Headed Bolts: ASTM A 490 (ASTM A 490M), Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.

I. Nonhigh-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers.
   1. Finish: Hot-dip zinc-coating, ASTM A 153, Class C.
J. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
   1. Finish: Hot-dip zinc-coating, ASTM A 153, Class C.
   2. Direct-Tension Indicators: ASTM F 959, Type 325.

K. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers, uncoated.
   1. Direct-Tension Indicators: ASTM F 959, Type 490, uncoated.

L. Welding Electrodes: Comply with AWS requirements.

2.2 PRIMER

A. Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements of FS TT-P-664.

2.3 GROUT

A. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404, Size No. 2. Mix at ratio of 1 part cement to 2-½ parts sand, by volume, with minimum water required for placement and hydration.

B. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

2.4 FABRICATION

A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.
   1. Camber structural steel members where indicated.
   2. Identify high-strength structural steel according to ASTM A 6 (ASTM A 6M) and maintain markings until steel has been erected.
   3. Mark and match-mark materials for field assembly.
   4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
   5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.

B. Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
   1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
   2. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.

C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded.

D. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.

E. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's printed instructions.

F. Steel Wall Framing: Select true and straight members for fabricating steel wall framing to be attached to structural steel framing. Straighten as required to provide uniform, square, and true members in completed wall framing.

G. Welded Door Frames: Build up welded doorframes attached to structural steel framing. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10” (250 mm) o.c., unless otherwise indicated.

H. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.
   1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
   2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

2.5 SHOP CONNECTIONS

A. Shop install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

B. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Shop install and tighten high-strength bolts according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
1. Bolts: ASTM A 490 (ASTM A 490M) high-strength bolts, unless otherwise indicated.

2. Connection Type: Slip-critical, direct-tension, or tensioned shear/bearing connections as indicated.

D. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds ½” (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

2.6 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2” (50 mm).

2. Surfaces to be field welded.

3. Surfaces to be high-strength bolted with slip-critical connections.

4. Surfaces to receive sprayed-on fireproofing.

5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications as follows:

1. SSPC-SP 3 "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

D. Painting: Apply a 1-coat, nonasphaltic primer complying with SSPC’s "Painting System Guide No. 7.00" to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.7 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.
2.8 SOURCE QUALITY CONTROL

A. University will engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.

2. Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Shop-bolted connections will be tested and inspected according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.

E. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.

1. Liquid Penetrant Inspection: ASTM E 165.

2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."


F. In addition to visual inspection, shop-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed when visual inspections reveal either less than a continuous 360° flash or welding repairs to any shear connector.

2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.
B. Do not proceed with erection until 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.

   1. Do not remove temporary shoring supporting composite deck construction 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 according to AISC specifications referenced in this Section.

B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

   1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.

   2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

   3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

      a. Comply with manufacturer's instructions for proprietary grout materials.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."


D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

   1. Level and plumb individual members of structure.

   2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

E. Splice members only where indicated.

F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
G. Finish sections thermally cut during erection equal to a sheared appearance.

H. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. Install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

B. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Install and tighten high-strength bolts according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. Bolts: ASTM A 490 (ASTM A 490M) high-strength bolts, unless otherwise indicated.

2. Connection Type: Slip-critical, direct-tension, or tensioned shear/bearing connections as indicated.

D. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of backside welding on exposed steel surfaces. Grind smooth exposed fillet welds ½" (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

3.5 FIELD QUALITY CONTROL

A. University will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Field-bolted connections will be tested and inspected according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.

E. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.

1. Liquid Penetrant Inspection: ASTM E 165.

2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."


F. In addition to visual inspection, field-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed when visual inspections reveal either less than a continuous 360° flash or welding repairs to any shear connector.

2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

3.6 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils (0.038 mm).

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

END OF SECTION 05 12 00
SECTION 05 31 00
STEEL DECKING

PART 1   GENERAL

1.1 SECTION INCLUDES

A. Steel decking and accessories.

B. Framing for openings up to and including 24 inches.

1.2 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete.

B. Section 05 12 00 – Structural Steel Framing.

C. Section 05 50 00 – Metal Fabrications.

1.3 REFERENCES

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only. Refer to Division 01 for definitions, acronyms, and abbreviations.

B. Unless otherwise noted, standards, manuals, and codes refer to the latest edition of such standards, manuals, and codes as of the date of issue of this Project Manual.

C. Referenced Standards:

1. AISI S100 – North American Specification for the Design of Cold-Formed Steel Structural Steel Members.

2. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.


1.4 SUBMITTALS

A. Submit under provisions of Division 01.

B. Shop Drawings: Indicate decking plan, dimensions, sizes, support locations, projections, openings and reinforcement, pertinent anchoring details and accessories. Coordinate with other trades in accurately locating and detailing openings and penetrations.

C. Product Data: Provide deck profile characteristics and dimensions, structural properties, finishes and accessories. Provide product data for acoustic insulation.
D. Manufacturer's Installation Instructions: Indicate specific installation sequence and special instructions.

E. Certificates:
   1. The manufacturer's certification and fire test reports to show that deck assemblies comply with requirements of this Section.
   2. Furnish certification by approved testing agency for each welder employed.

1.5 PERFORMANCE REQUIREMENTS
A. Steel decking and section properties shall comply with AISI S100.
B. Profile and design of deck units and accessories shall conform to the details shown on Drawings. Units shall be one piece, unless indicated otherwise.
C. Steel decking and its installation shall meet the requirements of 2013 California Building Code (CBC).

1.6 FIELD MEASUREMENTS
A. Verify that field measurements are as shown on shop drawings.

1.7 TESTS AND INSPECTIONS
A. Furnish test specimens of materials when they are requested. Welded decking in place is subject to inspection and testing per CBC Chapter 17A “Special Inspections and Tests”, Section 1705A “Required Verification and Inspection”.
   1. Expense of removing and replacing any portion of decking for testing purposes will be borne by Owner if installation is found to be satisfactory. All portions of the work found to be defective and not in conformity with contract requirements shall be removed and replaced at no cost to Owner.

1.8 QUALITY ASSURANCE
A. Testing Agency Qualifications: An independent agency qualified according to ASTM E329 for testing indicated.
B. Welding: Qualify procedures and personnel according to AWS D1.3.
C. Installer: Company specializing in performing work of this Section.

1.9 DELIVERY, STORAGE AND HANDLING
A. Deliver products to site under provisions of Division 01.
B. Store and protect products under provisions of Division 01.
C. Store decking on dry wood sleepers; slope for positive drainage. Work showing creases, burrs in cells, deformation, weathering, or other defects affecting its use or appearance in exposed locations will not be accepted.

PART 2  PRODUCTS
05 31 00 - 2
STEEL DECKING
2.1 MANUFACTURERS

A. Acceptable Manufacturer:


B. Substitutions: Under provisions of Division 01 with valid ICC Evaluation Report.

1. Substitution requests for steel decking shall consider the vertical and lateral load capacities of final system, including attachments. Provide a comparison summary of proposed and specified deck systems showing that the proposed system has equal or greater vertical and lateral load capacities for all conditions shown on Drawings. Systems with lower load capacities will not be acceptable.

2. Substitution requests will require review by the Structural Engineer of Record and OSHPD. Cost for such reviews shall be borne by Contractor.

3. Do not submit shop drawings with substituted decking manufacturer until decking manufacturer has been accepted via substitution request process.

2.2 MATERIALS

A. Sheet Steel: ASTM A653/A653M, SS designation, Grade 33 (minimum yield 38 KSI); zinc coated conforming to ASTM A653/A653M, G60. Refer to Drawings for types and sizes of steel decking.

B. Welding Materials: AWS D1.1 and D1.3.


D. Steel Decking and Design: Steel decking shall be metallic coated with interlocking side lap. Deck types and minimum structural properties shall be as indicated on Drawings. Submit ICC Reports that demonstrate compliance with design requirements.

2.3 FABRICATION

A. Fabrication: All steel decking units shall be roll-formed to assure uniformity and strength.

B. Allowable Tolerances: Maximum variation in unit alignment 1/4 inch in 40 feet (1/1920).

C. Workmanship: All work shall be neat, trim, true to line and upon completion shall present a true finished surface of specified deck profile, free of dents, deformations, creases, weld spatter or other noticeable defects. Special care shall be taken to prevent damage to decking in exposed locations.

D. Reinforcement: Provide reinforcement for openings, cutouts and free edges of decking as required for strength and stiffness. Provide reinforcement where a cell is cut parallel to rib as necessary to make a tight fit along the cut cell. Such reinforcement shall be in addition to structural supports shown on Drawings and specified in Section 05 12 00.

E. Miscellaneous Work: Provide all other transition pieces, reinforcement and miscellaneous decking items as detailed and required to provide a complete installation.
PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work. Check supporting members for correct layout and alignment. Should layout and alignment be such as to prevent proper bearing of the deck units on supporting members, the deck installer shall bring it to the attention of structural steel installer in writing, with a copy to Architect, for corrective measures and action. Steel decking units shall not be placed until necessary corrections are made.

B. Beginning of installation means installer accepts existing conditions.

3.2 INSTALLATION

A. Erect steel decking in accordance with ICC Evaluation Report, manufacturer's instructions and final shop drawings.

B. Placing and Fastening Deck Units: Place decking in a permanent position with all panels aligned end-to-end so that the fluted portions of the panels align accurately. Panels shall be placed on supporting framework and adjusted in final position before being permanently fastened. Ends shall be over structural supports with positive, complete bearing over full width of panels. Installation shall be accomplished without deformation of units. Decking layout shall be as indicated on Drawings.

1. Carefully check control points, as indicated, for layout of deck flutes. Where required, deck module shall be adjusted to conform to layout indicated.

2. Fasten deck units to structure and to each other as indicated.

3. At galvanized steel decks, touch-up all welds with zinc-rich primer.
   a. Exception: Do not touch-up welds on top of deck which will be covered with concrete.

4. Complete installation shall conform to manufacturer's specifications and as detailed.

C. Openings Through Decking: Steel decking fabricator shall cut and reinforce all openings in the metal deck, including framed openings indicated on Drawings. Small miscellaneous openings shall be field-cut by the trade requiring the opening.

1. All cutting of exposed edges shall be square, trim and equal to factory cutting.

2. Openings shall be reinforced as indicated or required to provide a rigid installation.

D. Steel decking installation shall proceed in accordance with current Cal/OSHA and OSHA regulations including guidelines with respect to fall protection.

E. Steel decking shall be spread for safety and working platforms.

F. All steel decking sheets shall be wind tacked and loose bundles of deck shall be wired at the end of each shift.

3.3 FIELD QUALITY CONTROL
A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Remove and replace work that does not comply with specified requirements.

   1. Additional inspection, at Contractor’s expense, will be performed to determine compliance of corrected work with specified requirements.

3.4 PROTECTION

A. Do not use steel decking for storage or working platforms until it has been permanently fastened. Storage loads must be supported on wood blocking in the flutes of the deck.

   1. Any damaged deck unit shall be repaired or replaced as directed by Architect and at no cost to Owner.

B. Assure that construction loads do not exceed the carrying capacity of the deck.

3.5 CLEAN-UP

A. Upon completion of the work of this Section, remove all surplus materials, rubbish and debris from premises.

END OF SECTION
SECTION 05 51 50
ALUMINUM CROSSOVER STAIR

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Aluminum crossover access stair.

1.2 RELATED SECTIONS
A. Section 07 50 00 – Single Ply Roofing.
B. Section 26 05 00 – Basic Electrical Materials and Methods: For electrical grounding of ladders.

1.3 REFERENCES
A. AA – Aluminum Association.
D. OSHA 1917.118 – Fixed Ladders.
E. California Code of Regulations, Title 8, Section 3277 – Fixed Ladders.

1.4 SUBMITTALS
A. Submit under provisions of Division 01.
B. Product Data: Manufacturer’s data sheets on each product.
C. Shop Drawings:
   1. Detail fabrication and erection of each ladder indicated. Include plans, elevations, sections, and details of metal fabrications and their connections.
   2. Provide templates for anchors and bolts specified for installation under other Sections.
   3. Provide reaction loads for each hanger and bracket.
D. Qualification Data:
   1. Refer to Quality Assurance provisions for submittal requirements evidencing experience, certifications and resources.

1.5 QUALITY ASSURANCE
A. Manufacturer Qualifications: A firm experienced in producing aluminum crossover stairs similar to those indicated for this Project.
   1. Record of successful in-service performance.
2. Sufficient production capacity to produce required units.

3. Professional engineering competent in design and structural analysis to fabricate aluminum crossover access stairs in compliance with industry standards and local codes.

B. Installer Qualifications: Competent and experienced firm capable of selecting fasteners and installing crossover access stairs to attain designed operational and structural performance.

C. Product Qualification: Product design shall comply with OSHA 1917.118 and California Code of Regulations, Title 8, Section 3277 minimum standards for ladders.

D. Store products in manufacturer's unopened packaging until ready for installation.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurement before fabrication.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, indicate established dimensions on shop drawing submittal and proceed with fabrication.

1.7 WARRANTY

A. Manufacturer has responsibility for an extended Corrective Period for work of this Section for a period of 5 years commencing on the shipment date of the product against all the conditions indicated below, and when notified in writing from Owner, manufacturer shall promptly and without inconvenience and cost to Owner correct said deficiencies.

1. Defects in materials and workmanship.

2. Deterioration of material and surface performance below minimum OSHA standards as certified by independent third party testing laboratory. Ordinary wear and tear, unusual abuse or neglect excepted.

3. Within the warranty period, the manufacturer shall, at its option, repair, replace, or refund the purchase price of defective aluminum crossover access stair.

B. Manufacturer shall be notified immediately of defective products, and be given a reasonable opportunity to inspect the goods prior to return. Manufacturer will not assume responsibility, or compensation, for unauthorized repairs or labor. Manufacturer makes no other warranty, expressed or implied, to the merchantability, fitness for a particular purpose, design, sale, installation, or use, of the stair; and shall not be liable for incidental or consequential damages, losses or expenses, resulting from the use of stair products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS


B. Substitutions: In accordance with provisions of Section 01 60 00.

C. Requests for substitutions will be considered in accordance with provisions of Division 01.

2.2 APPLICATIONS/SCOPE
A. Crossover Access Stair:
      a. Model 522A as manufactured by O’Keeffe’s Inc.
   2. Incline:
      a. 60 degree, unless otherwise indicated on Drawings.

2.3 FINISHES
A. Mill finish, as extruded.

2.4 MATERIALS
A. Aluminum Sheet: Alloy 5005-H34 to comply with ASTM B209.
B. Aluminum Extrusions: Alloy 6063-T6 to comply with ASTM B221.

2.5 FABRICATION
A. Crossover Access Stairs: Treads shall be not less than 1-1/4 inches high, 4-1/8 inch deep and 2 feet wide; serrated tread spacing shall be 1 foot on center. Handrails shall be aluminum pipe, not less than 1-1/2 inches in diameter with hemispheric end caps.
B. Stringers and Landing Platform: 2" X 6" Aluminum extruded channel stringers, with 1-1/2 inches diameter guardrails, and decks of 1-1/4" X 6"serrated aluminum treads.
C. Seismic Bottom Support: Manufacturer’s standard SB bracket; two isolation bearings per stringer.
D. Construction shall be self-locking stainless steel fasteners, full penetration TIG welds and clean, smooth and burr-free surfaces.
E. Treads and landing shall withstand a 1,500 pound load without deformation or failure.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Coordinate anchorages. Furnish setting drawings, templates, and anchorage structural loads for fastener resistance.
B. Do not begin installation until supporting structure is complete and crossover access stair installation will not interfere with supporting structure work.
C. If supporting structure is the responsibility of another installer, notify Architect of unsatisfactory supporting work before proceeding.

3.2 INSTALLATION
3.3 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 05 51 50
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work of this Section shall include all materials and installation necessary to provide pipe and tube railings as shown and detailed on the Drawings and specified herein.

B. This Section includes the following:
   1. Steel pipe and tube handrails and railings.

1.2 SUBMITTALS

A. Product Data: For the following:
   1. Manufacturer's product lines of mechanically connected handrails and railings.
   2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Show fabrication and installation of handrails and railings. Include plans, elevations, sections, component details, and attachments to other Work.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for products with factory-applied color finishes.

D. Samples for Initial Selection: Short sections of railing or flat, sheet metal samples showing available mechanical finishes.

E. Samples for Verification: For each type of exposed finish required, prepared on components indicated below and of same thickness and metal indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
   1. ±6" (150-mm) long sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
   2. Fittings and brackets.
   3. Assembled sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Sample need not be full height.

1.3 STORAGE

A. Store handrails and railings in a dry, well-ventilated, weather tight place.
1.4 PROJECT CONDITIONS
   A. Field Measurements: Verify handrail and railing dimensions by field measurements
      before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication
      schedule with construction progress to avoid delaying the Work.

1.5 COORDINATION
   A. Coordinate installation of anchorages for handrails and railings. Furnish setting
      drawings, templates, and directions for installing anchorages, including sleeves, concrete
      inserts, anchor bolts, and items with integral anchors, that are to be embedded in
      concrete or masonry.

1.6 SCHEDULING
   A. Schedule installation so handrails and railings are mounted only on completed walls. Do
      not support temporarily by any means that does not satisfy structural performance
      requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Manufacturers: Subject to compliance with requirements.
      1. Steel Pipe and Tube Railings:
         a. Humane Equipment Co.
         b. Wagner: R & B Wagner, Inc.
         c. Or equal.

2.2 METALS
   A. General: Provide metal free from pitting, seam marks, roller marks, stains,
      discolorations, and other imperfections where exposed to view on finished units.
   B. Steel and Iron: Provide steel and iron in the form indicated, complying with the following
      requirements:
      1. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:
         a. Black finish, unless otherwise indicated.
         b. Galvanized finish for exterior installations and where indicated.
         c. Type F, or Type S, Grade A, standard weight (Schedule 40), unless
            another grade and weight are required by structural loads.
      2. Steel Tubing: Cold-formed steel tubing, ASTM A 500, Grade A, unless another
         grade is required by structural loads.
      3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.3 WELDING MATERIALS, FASTENERS, AND ANCHORS

A. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Fasteners for Anchoring Handrails and Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring handrails and railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Handrail and Railing Components: Use fasteners fabricated from same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

1. Provide concealed fasteners for interconnecting handrail and railing components and for attaching them to other work, unless otherwise indicated.

2. Provide concealed fasteners for interconnecting handrail and railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for handrails and railings indicated.

3. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

2.4 PAINT

A. Shop Primers: Provide primers to comply with applicable requirements in Division 09 Section "Painting."

2.5 FABRICATION

A. General: Fabricate handrails and railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble handrails and railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Welded Connections: Fabricate handrails and railings for connecting members by welding. Cope components at perpendicular and skew connections to provide close fit,
or use fittings designed for this purpose. Weld connections 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 flux immediately.

4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

E. Nonwelded Connections: Fabricate handrails and railings by connecting members with concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

F. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.

G. Provide inserts and other anchorage devices for connecting handrails and railings to metal stud framing or concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.

H. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

I. Ease exposed edges to a radius of approximately \( \frac{1}{32}\)" (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

J. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.

K. Fabricate joints that will be exposed to weather in a watertight manner.

L. Close exposed ends of handrail and railing members with prefabricated end fittings.

M. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of railing and wall is \( \frac{1}{4}\)" (6 mm) or less.

N. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.6 FINISHES, GENERAL

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. Provide any exposed fasteners with finish matching appearance, including color and texture, of handrails and railings.

2.7 STEEL FINISHES

A. Preparation for Shop Priming: Thoroughly clean handrails and railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.

B. Apply shop primer to prepared surfaces of handrail and railing components, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Stripe paint edges, corners, crevices, bolts, and welds.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required to install handrails and railings. Set handrails and railings accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.

1. Do not weld, cut, or abrade surfaces of handrail and railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

2. Set posts plumb within a tolerance of $\frac{1}{16}$" in 3’ (2 mm in 1 m).

3. Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed $\frac{1}{4}$" in 12’ (5 mm in 3 m).

C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

D. Adjust handrails and railings before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing handrails and railings and for properly transferring loads to inplace construction.
3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of handrails and railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to wall with wall brackets. Provide bracket with 1-½" (38-mm) clearance from inside face of handrail and finished wall surface.

B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

2. For hollow masonry anchorage, use toggle bolts.

3. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.

3.5 CLEANING

A. Clean steel by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 Section "Painting."

3.6 PROTECTION

A. Protect finishes of handrails and railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.
DIVISION 07
THERMAL AND MOISTURE PROTECTION
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work of this Section shall include all materials and installation necessary to provide Sheet Membrane Waterproofing as shown and detailed on the Drawings and specified herein, including:

2. Fully adhered sheet membrane waterproofing applied to vertical surfaces.
3. Drainage Composite.

B. Related Sections: Other specification sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 03 31 00 – EARTHWORK
2. Division 3 – CONCRETE

1.2 REFERENCE STANDARDS

A. The following standards and publications are applicable to the extent referenced in the text.

B. American Society for Testing and Materials (ASTM)


1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations. Include certification of data indicating VOC (Volatile Organic Compound) content of all component of waterproofing system.

B. Samples: Submit representative samples of the following for approval:

1. Sheet membranes.

2. Protection Board.

C. Manufacturers Installation Instructions: Indicating special procedures and perimeter conditions requiring special attention.

1.4 QUALITY ASSURANCE

A. Manufacturer: Sheet membrane waterproofing system shall be manufactured and marketed by a firm with a minimum of 20 years experience in the production and sales of self-adhesive sheet membrane waterproofing. Manufacturers proposed for use but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past 5 years.

B. Installer: A firm which has a least 3 years experience in work of the type required by this section.

C. Materials: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer.

D. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.

E. Manufacturer's Representative: Make arrangements necessary to have a trained employee of the manufacturer on-site periodically during membrane waterproofing work to review installation procedures.
1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer’s instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

1. Do not double-stack pallets of membrane on the job site. Provide cover on top and all sides, allowing for adequate ventilation.

2. Protect mastic and adhesive from moisture and potential sources of ignition.

3. Store protection board flat and off the ground. Provide cover on top and all sides.

4. Protect surface conditioner from freezing.

B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.6 PROJECT CONDITIONS

A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.

B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive sheet membrane waterproofing.

1.7 WARRANTY

A. Sheet Membrane Waterproofing: Provide written 10 year material warranty issued by the membrane manufacturer upon completion of work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sheet Membrane Waterproofing System: Bituthene® System 4000 by Grace Construction Products:

1. A self-adhesive, cold-applied Composite sheet consisting of a thickness of 1.4 mm (0.056") of rubberized asphalt and 0.1 mm (0.004") of cross-laminated, high-density polyethylene film specially formulated for use with water-based surface conditioner. Provide rubberized asphalt membrane covered with a release sheet which is removed during installation. No special adhesive or heat shall be required to form laps.
PHYSICAL PROPERTIES FOR BITUTHENE SYSTEM 4000:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td></td>
<td>Dark gray-black</td>
</tr>
<tr>
<td>Thickness</td>
<td>ASTM D 3767</td>
<td>1.5 mm (0.060&quot;) nominal</td>
</tr>
<tr>
<td>Flexibility, 180° Bend over 25 mm (1 in.) Mandrel at -43°C (-45°F)</td>
<td>ASTM D 1970</td>
<td>Unaffected</td>
</tr>
<tr>
<td>Tensile Strength, Membrane Die Modified</td>
<td>ASTM D412</td>
<td>2240 KN/m² (325 lb/in²) minimum</td>
</tr>
<tr>
<td>Tensile Strength Film</td>
<td>ASTM D882</td>
<td>34500 KN/m² (5000 lb/in²) minimum</td>
</tr>
<tr>
<td>Elongation Ultimate Failure of Rubberized Asphalt</td>
<td>ASTM D 412</td>
<td>300% minimum</td>
</tr>
<tr>
<td>Cycling Over 6 mm (0.25 in.) Crack at -32°C (-25°F) 100 Cycles</td>
<td>ASTM C 836</td>
<td>Unaffected</td>
</tr>
<tr>
<td>Lap Adhesion at Minimum Application Temperature</td>
<td>ASTM D 1876</td>
<td>880 N/m (5.0 lb/in.)</td>
</tr>
<tr>
<td>Peel Strength</td>
<td>ASTM 903</td>
<td>1576 N/m (9 lb/in.)</td>
</tr>
<tr>
<td>Puncture Resistance Membrane</td>
<td>ASTM E 154</td>
<td>222 N/m (50 lb) minimum</td>
</tr>
<tr>
<td>Resistance to Hydrostatic Head</td>
<td>ASTM D 5385</td>
<td>70 m (231 ft.) of water</td>
</tr>
<tr>
<td>Exposure to Fungi in Soil, 16 Weeks</td>
<td>GSA-PBS 07115</td>
<td>Unaffected</td>
</tr>
<tr>
<td>Permanence Method B</td>
<td>ASTM E 96</td>
<td>2.9 ng/m²sPa (0.05 perms) maximum</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>ASTM D 570</td>
<td>0.1% maximum</td>
</tr>
</tbody>
</table>

2. Surface Conditioner: Bituthene System 4000 Surface Conditioner.

3. Protection Board:
a. Drainage Composition: Hydrotect 220 by Grace Construction Products. Use Drainage Board over Bituthene 4000 in vertical applications. Drainage composite to meet the following criteria:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRAINAGE CORE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polymer</td>
<td>ASTM C 366</td>
<td>High impact Polystyrene</td>
</tr>
<tr>
<td>Thickness</td>
<td>Method B</td>
<td>9.5 mm (0.375&quot;) nominal</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>ASTM D 1621</td>
<td>718 kPa (15,000 lb/ft²)</td>
</tr>
<tr>
<td>Flow Rate (gradient 0.1, 37.9 kPa)</td>
<td>ASTM D 4716</td>
<td>0.003 m³/s (15 gal/min./ft)</td>
</tr>
<tr>
<td>GEOTEXTILE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td></td>
<td>Nonwoven</td>
</tr>
<tr>
<td>Polymer</td>
<td></td>
<td>Polypropylene</td>
</tr>
<tr>
<td>Weight</td>
<td>ASTM D 3776</td>
<td>136 g/m² (4.0 oz/yd²)</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>ASTM D 4632</td>
<td>445 N (100 lb)</td>
</tr>
<tr>
<td>Trapezoidal Tear</td>
<td>ASTM D 4533</td>
<td>222 N (50 lb)</td>
</tr>
<tr>
<td>Apparent Opening Size</td>
<td>ASTM D 4751</td>
<td>0.150-0.212 mm (70-100 U.S. sieve)</td>
</tr>
<tr>
<td>Permittivity</td>
<td>ASTM D 4491</td>
<td>6095 L/min./m² (150 gal/min./ft²)</td>
</tr>
<tr>
<td>Mullen Burst</td>
<td>ASTM D 3786</td>
<td>1860 kPa (270 lb/in.²)</td>
</tr>
<tr>
<td>Puncture Strength</td>
<td>ASTM D 4833</td>
<td>35 kg (75 lb)</td>
</tr>
</tbody>
</table>


B. Preapplied sheet: Waterproofing Membrane: Bituthene® Preprufe™ 300

1. Waterproofing Membrane by Grace Construction Products, a four-layer composite sheet membrane consisting of 0.8 mm (0.030") of high-density polyethylene film, 0.5 mm (0.025") of specially formulated synthetic adhesive and 0.03 mm (0.001") of protective coating and surface treatment.

2. Preapplied Sheet Waterproofing Membrane
PHYSICAL PROPERTIES FOR BITUTHENE PREPRUFE 300 MEMBRANE:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td></td>
<td>Black with white</td>
</tr>
<tr>
<td>Protective coating and white</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface treatment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td>ASTM D 3767</td>
<td>1.42 mm (0.056&quot;)</td>
</tr>
<tr>
<td>Thickness, nominal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Temperature Flexibility</td>
<td>ASTM D 1970</td>
<td>Unaffected at -23°C (-10°F)</td>
</tr>
<tr>
<td>Elongation</td>
<td>ASTM D 412</td>
<td>300% minimum</td>
</tr>
<tr>
<td>Crack Cycling</td>
<td>ASTM C 836</td>
<td>Unaffected at -23°C (-10°F),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 Cycles</td>
</tr>
<tr>
<td>Tensile Strength, Film</td>
<td>ASTM D 412</td>
<td>27 600 kPa (4,000 lb/in.²)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>minimum</td>
</tr>
<tr>
<td>Puncture Resistance</td>
<td>ASTM E 154</td>
<td>800 N (180 lb)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>minimum</td>
</tr>
<tr>
<td>Peel Adhesion to Concrete</td>
<td>ASTM D 903</td>
<td>880 N/m (5.0 lb/in.) minimum</td>
</tr>
<tr>
<td>Modified</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lap Adhesion</td>
<td>ASTM D 1876</td>
<td>440 N/m (2.5 lb/in.) minimum</td>
</tr>
<tr>
<td>Modified</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance to Hydrostatic Head</td>
<td>ASTM D 5385</td>
<td>70 m (231 ft.) minimum</td>
</tr>
<tr>
<td>Modified</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanence</td>
<td>ASTM E 96</td>
<td>0.6 ng/m²sPa (0.01 perms)</td>
</tr>
<tr>
<td>Method B</td>
<td></td>
<td>maximum</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>ASTM D 570</td>
<td>0.5% maximum</td>
</tr>
</tbody>
</table>

PART 3 - EXECUTION

3.1 EXAMINATION

A. The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 PREPARATION OF SUBSTRATES
A. Refer to manufacturer's literature for requirements for preparation of substrates. Surfaces shall be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods which are acceptable to manufacturer of sheet membrane waterproofing.

B. Cast-In-place Concrete Substrates:

1. Do not proceed with installation until concrete has properly cured and dried (minimum 7 days for normal structural concrete and minimum 14 days for lightweight structural concrete).

2. Fill form tie rod holes with concrete and finish flush with surrounding surface.

3. Repair bugholes over 13 mm (0.5") in length and 6 mm (.25") deep and finish flush with surrounding surface.

4. Remove scaling to sound, unaffected concrete and repair exposed area.

5. Grind irregular construction joints to suitable flush surface.

C. Related Materials: Treat joints and install flashing as recommended by waterproofing manufacturer.

3.3 INSTALLATION OF PREPRUFE 300 MEMBRANE

A. Refer to manufacturer's literature for recommendations on installation, including but not limited to the following:

1. Apply membrane with the HDPE film facing the well compacted crushed stone substrate. Remove the release liner and fasten membrane to existing condition. Surface does not need to be dry, but standing water must be removed.

2. Apply succeeding sheets by overlapping the previous sheet 75 mm (3") along the uncoated edge of the membrane.

3. Overlap the ends of the membrane 75 mm (3"). Apply Biluthene® Preprufe™ Tape centered over the end lap and roll firmly. Remove release liner.

3.4 INSTALLATION OF 4000 MEMBRANE

A. Refer to manufacturer's literature for complete installation instructions, but not limited to the following:

1. Apply surface conditioner treatment at dilution and rate recommended by manufacturer. Recoat areas not waterproofed if contaminated by dust. Mask and protect adjoining exposed finish surfaces to protect those surfaces from excessive application of surface conditioner/primer.

2. Delay application of membrane until surface conditioner is completely dry. Dry time will vary with weather conditions.

3. Seal daily terminations with troweled bead of mastic.
4. Apply protection board and related materials in accordance with manufacturer's recommendations.

3.5 INSTALLATION OF HYDRODUCT 220 DRAINAGE COMPOSITE

A. In vertical applications, Hydroduct 220 Drainage Composite can be applied to the substrate vertically or horizontally but, in either case, should extend to a point approximately 150 mm (6") below the anticipated grade line.

B. When Adhering Hydroduct 220 Drainage Composite directly to Bituthene waterproofing membranes, Bitustik Tape should be used. When using Bitustik Tape, press firmly to ensure good adhesion. Substrate and job site conditions will determine the attachment pattern. Abut adjacent rolls with excess fabric overlapping in shingle fashion.

C. For inside and outside corners, abut adjoining drainage composite at the corner. Cover open core with extra geotextile filler fabric.

D. The exposed core along the top terminations should be covered with a strip of geotextile to prevent intrusion of soil into core. Terminate Hydroduct 220 Drainage Composite at the bottom of the concrete structure.

E. To secure Hydroduct 220 Drainage Composite around protrusions, apply Bitustik Tape around the protrusion in a picture frame configuration. Cut Hydroduct 220 Composite to fit snugly around the protrusion. Press the cut edge firmly into the Bitustik Tape.

F. Hydroduct 220 Drainage Composite should be covered promptly. Do not leave Hydroduct 220 Drainage Composite exposed to sunlight for more than two weeks.

3.6 CLEANING AND PROTECTION

A. Remove any masking materials after installation. Clean any stains on materials which would be exposed in the completed work.

B. Protect completed membrane waterproofing from subsequent construction activities as recommended by manufacturer.

END OF SECTION 07 13 00
PART 1    GENERAL

1.01    SECTION INCLUDES

A. Work under this Section consists of the furnishing of all labor, materials, equipment and services necessary for, and incidental to, the complete and proper installation of all spray-applied fireproofing and related work as shown on Drawings or specified in this Section, and in accordance with all applicable requirements of the contract documents.

1. The following schedule is used in the specification:

   a. Type II – Medium density Portland cement fireproofing.

B. The material and installation shall conform to the applicable building code requirements of all authorities having jurisdiction.

C. For patch and repair work, match existing adjacent fireproofing thickness to obtain the code-required fire rating for that location.

1.02    RELATED SECTIONS

A. Section 01 73 29 – Cutting and Patching.

B. Divisions 21 - 23 – Mechanical.

C. Divisions 25 - 28 – Electrical.

1.03    REFERENCES

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only. Refer to Section 01 42 00 for definitions, acronyms, and abbreviations.

B. Unless otherwise noted, standards, manuals, and codes refer to the latest edition of such standards, manuals, and codes as of the date of issue of this Project Manual.

C. Referenced Standards:


15. SFM Approved Materials and Equipment Listing Services.

1.04 SUBMITTALS

A. Submit all information under provisions of Section 01 33 23.

B. Manufacturers’ Data:

1. Submit manufacturer’s instructions for proper application of sprayed fireproofing.

2. Submit product data indicating UL listings, product characteristics and performance and limitation criteria.

C. Submit manufacturer’s certificate under provisions of Section 01 33 23 stating that products meet or exceed the specified requirements.

D. Test Data: From a qualified independent testing agency employed and paid by the manufacturer. Provide reports indicating that physical properties of proposed sprayed on fireproofing products comply with specified requirements based on comprehensive testing of current product formulations according to the following requirements:

1. Testing is performed on sprayed on fireproofing materials randomly selected from bags bearing the applicable classification marking of UL or another inspecting and testing agency acceptable to authorities having jurisdiction.

2. Testing is performed on specimens of sprayed on fireproofing materials that comply with laboratory testing requirements specified in Part 2 and are otherwise identical in every respect to the installed fireproofing including application of sealers, topcoats, tamping, troweling, rolling and water overspray, if any of these are used in final application.
3. Qualified independent testing agency does testing on laboratory specimens that it witnessed during preparation and conditioning. Include in test reports a full description of preparation and conditioning of laboratory test specimens.

4. Test reports without the above information are not acceptable.

E. Fire Testing: Submit evidence that the cementitious fireproofing has been subjected to full scale ASTM E84 and ASTM E119 fire testing by Underwriters Laboratories Inc. Include evidence that the fire testing was sponsored by the manufacturer and that the material tested was produced at the manufacturer's facility under the supervision of Underwriters Laboratories Inc. personnel. Letters documenting classification status are not acceptable evidence of compliance with this Section.

F. Test Reports:

1. Submit all test reports under provisions of Section 01 33 23.

2. For primers and other coatings applied to structural steel from a qualified independent testing agency employed and paid by Contractor indicating that primers and coatings proposed for application in shop or field are compatible with sprayed on fireproofing. Instruct laboratory to determine compatibility as follows:

   a. By testing for bond per ASTM E736 and requirements specified in UL "Fire Resistance Directory" about coating materials.

   b. By verifying that fireproofing manufacturer has not found primers or coatings to be incompatible with fireproofing based on its own laboratory testing or field experience.

G. Shop Drawings: Submit shop drawings indicating the following:

1. Where and what kinds of surface preparations are required before applying fireproofing.

2. Extent of sprayed fire resistive material for each different construction and fire resistance rating including the following:

   a. Applicable fire resistive design designations of inspecting and testing agency applicable to authorities having jurisdiction.

   b. Minimum thickness needed to achieve required fire resistance ratings of structural components and assemblies.

   c. Treatment of fireproofing after its application.

H. ICC Evaluation reports or research reports of the model code organization acceptable to authorities having jurisdiction showing that the sprayed fire resistive material complies with the building code in effect for the Project.

I. Request for Substitution: Provide the following information with any request for substitution on the item or process that is being requested to be substituted:

1. A complete description of the item or process.

2. Samples of color and texture.
3. Submit a complete thickness schedule for each structural component and assembly to be fireproofed.

4. Performance characteristics and production rates. All performance tests shall be conducted at the average density listed in the UL Fire Resistance Directory.

5. A list of at least three other projects of similar nature to this contract where the products have been in use for at least one year, including telephone number and person to contact at these other projects.

6. An analysis of the effect of the substitution on the schedule and contract cost and on the overall project as it relates to adjoining work.

1.05 QUALITY ASSURANCE

A. Fireproofing work shall be installed by a firm with not less than three years of successful experience in the application of specified fireproofing materials on projects of similar scope. Applicator shall be licensed or otherwise approved in writing by the manufacturer of fireproofing materials.

B. Products, execution and fireproofing thickness and density shall conform to the applicable code requirements for the required fire-resistance ratings for the type of member / assembly to be fireproofed.

C. Sprayed fireproofing shall form a sound bond with the steel.

D. Prior to the execution of work, Contractor shall call a pre-installation meeting to review product selection, check substrates for acceptability, verify designs and thickness, discuss inspection procedures, and coordinate the fireproofing installation with the work of other trades. The meeting shall be attended by Contractor, fireproofing applicator, an employee of the fireproofing manufacturer, and a representative of the independent testing agency.

E. Obtain sprayed fire resistive materials for all required products from a single manufacturer.

F. Prior to installation of the fireproofing, prepare a sample installation of at least 100 square feet over a representative area on site. The sample area shall be tested for density, and bond strength to assure compliance with the submitted independent laboratory reports or the project requirements.

G. Sprayed fireproofing shall meet requirements of systems approved by State Fire Marshal and local Building Inspector.

H. Applicator Qualifications: Applicator shall be approved by sprayed fireproofing manufacturer, including qualified factory training where recommended by manufacturer.

I. Fireproofing products shall be 100 percent free of asbestos and mineral wool fibers and contain less than ten percent vermiculite.

1.06 DELIVERY, STORAGE AND HANDLING

A. Conform to the requirements specified in Section 01 60 00.

B. Material shall be delivered in original unopened packages, fully identified as to manufacturer, brand or other identifying data, and bearing the proper Underwriters' Laboratories, Inc. labels for fire hazard and fire-resistance classification.
C. Material shall be stored (above ground), under cover and in a dry location until ready for use. All bags that have been exposed to water before use shall be found unsuitable for use and discarded. Stock of material is to be rotated and used prior to its expiration date.

D. Leave seals unbroken and labels intact until time of use. Remove from job site any rejected or damaged packages found unsuitable for use. Remove from job site any bags of sprayed fireproofing materials that have been exposed to water before use.

1.07 PROJECT/SITE CONDITIONS

A. A minimum temperature of 40 degrees F for air and substrate must be maintained for 24 hours before, during and for 24 hours after application of the sprayed fireproofing. If necessary for job progress, Contractor shall provide enclosures with heat to maintain temperatures.

B. Contractor shall provide ventilation to allow for proper drying of the fireproofing during and subsequent to its application. In poorly ventilated areas lacking natural ventilation, forced air ventilation (minimum total air exchange rate of four times per hour) shall be employed to cause the material to become substantially dry.

C. Protection:

1. Protect adjacent surfaces and equipment from damage by overspray, fall-out and dusting-off of sprayed fireproofing materials.

2. Provide temporary enclosures to prevent spray fireproofing from contaminating air.

3. Provide means to prevent damage to sprayed fireproofing from inclement weather.

4. Provide tarping of all floor areas where spray fireproofing is to occur.

1.08 SEQUENCING

A. Prior to installation of sprayed fireproofing all other trades must have completed installation of all items such as hangers, clamps, and other attachments for work suspended from, attached to, or passing through construction required to receive sprayed fireproofing.

B. Apply sprayed fireproofing prior to installation of ducts, piping conduit, and other work preventing correct application.

1.09 WARRANTY

A. Special Project Warranty: Submit written warranty, executed by Contractor and cosigned by Installer, agreeing to repair/replace fireproofing work of this Section, which has cracked, flaked, dusted excessively, peeled or fallen from substrate, or otherwise deteriorated to a condition where it would not perform effectively as intended for fireproofing purposes; due substantially to defective materials or workmanship and not due to abuse by occupants, improper maintenance, unforeseeable ambient exposure, or other causes beyond anticipated conditions and Contractor’s/Installer’s control. Warranty period shall be two years after date of final project completion.
PART 2  PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

A. Acceptable Manufacturers and Products:


B. Substitutions: Under provisions of Section 01 60 00.

2.02 MATERIALS

A. The sprayed material shall be a factory blended cementitious fireproofing which when mixed at the jobsite with water and applied will provide compliance with all Drawings, Specifications and the following physical performance test criteria:

1. Dry Density: The field density shall be measured, in accordance with ASTM Standard E605. Minimum average density shall be 22 pounds per cubic foot as listed in the UL Fire Resistance Directory, ICC Evaluation Report or as required by the authority having jurisdiction.

2. Deflection: Material shall not crack or delaminate from the surface to which it is applied when tested in accordance with ASTM E759.

3. Bond Impact: Material subject to impact tests in accordance with ASTM E760 shall not crack or delaminate from the surface to which it is applied.

4. Bond Strength: Fireproofing, when tested in accordance with ASTM E736, shall have a minimum average bond strength of 1,000 pounds per square foot and a minimum individual bond strength of 800 pounds per square foot.

5. Air Erosion: Maximum allowable weight loss of the fireproofing material shall be 0.005 grams per square foot when tested in accordance with ASTM E859.

6. Compressive Strength: The fireproofing shall not deform more than ten percent when subjected to compressive forces of 10,000 pounds per square foot when tested in accordance with ASTM E761.

7. Corrosion Resistance: Steel with applied fireproofing shall be tested in accordance with ASTM E937 and shall not promote corrosion of steel.

8. Durometer Hardness: The fireproofing material shall have a minimum Duromter Hardness value of 10 when tested in accordance with ASTM D2240.

9. Surface Burning Characteristics: Material shall exhibit the following surface burning characteristics when tested in accordance with ASTM E84:

   a. Flame Spread: 0.

   b. Smoke Development: 0.
10. Mold Resistance: Fireproofing material shall be tested in accordance with ASTM G21 and shall show resistance to mold growth for a period of sixty days.

B. The sprayed fireproofing material shall have been tested and reported by Underwriters' Laboratories, Inc. in accordance with the procedures of ASTM E119.

C. Mixing water shall be clean, fresh and suitable for domestic consumption and free from such amounts of mineral or organic substances as would affect the set of the fireproofing

PART 3 EXECUTION

3.01 EXAMINATION

A. All surfaces to receive sprayed fireproofing shall be free of oil, grease, rolling compounds or lubricants, loose mill scale, excess rust, non-compatible primer, lock down agent, dirt or any other foreign substances that will impair proper adhesion of the fireproofing to the substrate. Where necessary, cleaning of surfaces to receive fireproofing shall be the responsibility of Contractor.

B. Structural steel surfaces shall be compatible with sprayed fireproofing.

1. Primed structural steel shall be tested and reported by Underwriters' Laboratories. The report shall indicate approval for the specific primer and its use on the maximum uninterrupted span of the structural steel surface. All primed structural steel shall bear the appropriate Underwriters' Laboratories Inc. label indicating compliance.

2. Where a corrosive environment such as where excessive moisture or free water will contact the fireproofing or fireproofed member, a coating must be applied to prevent corrosion of the steel surfaces. The coating must be applied prior to the fireproofing application. The coatings manufacturer shall certify as to the compatibility of the coating with Portland cement based products and as to the degree of corrosion protection offered. Underwriters' Laboratories, Inc. has specific Requirements when coatings are used as substrates for fireproofing materials.

3. Rolling compounds or lubricants:

a. Architect shall determine whether the lock-down agent and/or primer has been tested in accordance with ASTM E119 with the specified sprayed replacement fireproofing material to provide the required fire resistant rating.

b. Steel surfaces that have been sprayed with a lock-down agent and/or primer will require a fireproofing bond test to determine if the lock-down formulation or primer will impair proper adhesion. Determination of the compatibility for the lock-down agent and/or primer with the sprayed fireproofing shall be the responsibility of the lock-down and/or primer manufacturer.

C. Application of the fireproofing shall not begin until Contractor, applicator, and fireproofing testing laboratory (inspector) have examined surfaces to receive fireproofing and determined that the surfaces are acceptable to receive the fireproofing material.

3.02 PREPARATION

A. Prior to application of fireproofing, clips, hangers, support sleeves and other attachments required to penetrate the fireproofing shall be in place.

B. Ducts, piping, equipment or other suspended matter which would interfere with application of fireproofing materials shall not be positioned until fireproofing work is complete.
C. Provide masking, drop cloths or other satisfactory coverings to prevent overspray of sprayed fireproofing.

D. Where concrete, masonry or other surfaces subject to overspray are to remain permanently exposed, they shall be protected with masking, drop cloths or other satisfactory coverings.

E. Fireproofing is slippery when wet. Contractor and Applicator shall be responsible for posting appropriate cautionary SLIPPERY WHEN WET signs. Signs shall be posted in all areas in contact with wet fireproofing material. In addition, Contractor shall be responsible for appropriate barriers to prevent entry by non-fireproofing workers into the fireproofing spray and mixer areas or other areas exposed to wet fireproofing material.

F. Prior to application of the fireproofing material to all concrete substrates, a bonding agent approved by the fireproofing material manufacturer, shall be applied.

3.03 APPLICATION

A. Equipment and application procedure shall conform to the material manufacturer's application instructions.

B. Patching Existing Fireproofing: A discontinuous textured spray of W. R. Grace & Co. Spatterkote Type SK-3 shall be applied to all cellular steel floor units with flat plate on the bottom and to roof deck assemblies as required to meet the fire resistance ratings. Before application of the Retro-Guard RG-1 fireproofing, Spatterkote Type SK-3 shall be applied in accordance with manufacturer's application instructions.

C. Apply sprayed fire resistive material that is identical to products tested as specified in this Section, with respect to use of sealers, topcoats, tamping, troweling, water overspray or other materials and procedures affecting the test results.

D. Maintain ambient conditions during installation and for cure period following installation, as recommended by manufacturer. Provide ventilation and avoid excessive rate of drying. Protect from exposure to sun.

E. Utilize probes or other approved means to determine thickness during application.

3.04 FIELD QUALITY CONTROL

A. Owner will pay an independent testing laboratory to sample and verify the thickness and density of the fireproofing in accordance with provisions of ASTM E605, "Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Materials Applied to Structural Members," the "Inspection Procedure for Field-Applied Sprayed Fire Protection Materials" as published by the AWCI. Where density samples are of irregular shape, a displacement method approved by Underwriters Laboratories Inc. shall be used to determine in place fireproofing density.

B. Owner will pay an independent testing laboratory to randomly sample and verify the bond strength of the fireproofing in accordance with provisions of ASTM E736.

C. The results of the above tests shall be made available to all parties at the completion of each floor.

D. Areas not in compliance will be reported for proper repair. Contractor shall patch areas from which testing samples have been removed.
E. Repair or replace fireproofing found (by field tests) to be below compliance requirements. Add extra course of fireproofing material where feasible to achieve compliance; otherwise remove course and replace with newly installed complying work.

3.05 CLEANING

A. After the completion of fireproofing work, application equipment shall be removed.

B. Floors, walls, and other adjacent surfaces shall be left in a clean condition.

C. Immediately upon completion of spraying operations in each containable area of project, remove over-spray and fall-out of materials from surfaces of the work, and clean surfaces to remove evidence of soiling. Repair or replace damaged work to restore surfaces to acceptable condition.

3.06 PATCHING

A. Maintain protection of structure afforded by fireproofing by patching any areas which have been removed or damaged.

B. All patching and repairing of spray-applied fireproofing, due to damage by other trades, shall be performed with same materials under this Section, and paid for by the trade(s) responsible for the damage.

3.07 PROTECTION

A. Protection: Installer of sprayed-on fireproofing shall advise Contractor of protection requirements for fireproofing work, which will ensure that fireproofing will be substantially without damage or deterioration at time of final completion of project. Provide protection from reasonably predictable harmful exposures. Repair or replace work which has not been successfully protected.

END OF SECTION 07 81 16
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mineral wool safing insulation in wall and floor/ceiling construction.
B. Firestop sealants and caulks.
C. Elastomeric firestop sealants.
D. Firestop putty.
E. Intumescent putty pads.
F. Flexible firestop spray.
G. Firestop collars.
H. Firestopping for large openings.
I. Firestop pillows.
J. Cast-in-place firestop devices.
K. Intumescent wrap.
L. Firestop mortar.
M. Fire-rated cable pathway.
N. Fire-rated HVAC retaining angles.
O. Firestop plugs.
P. Fire-rated T collar devices.
Q. Fire-rated grommets.

1.2 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete.
B. Section 07 92 00 – Caulking and Sealants.
C. Section 09 29 00 – Gypsum Board.
D. Divisions 21 - 23 Sections, as applicable to mechanical work.
E. Divisions 25 - 28 Sections, as applicable to electrical work.

1.3 REFERENCES
A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only. Refer to Section 01 42 00 for references.

B. Unless otherwise noted, standards, manuals, and codes refer to the latest edition of such standards, manuals, and codes as of the date of issue of this Project Manual.

C. Referenced Standards:

5. ASTM E2174 – Standard Practice for On Site Inspection of Installed Fire Stops.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 23.

B. Provide manufacturer’s brochures describing firestop materials and insulation proposed for use, and types of mechanical fasteners to be used in the installation of the firestopping materials.

C. Certificates of Compliance: Before installation of products specified in this Section, Contractor shall furnish to Architect a certificate certifying that materials to be incorporated in the work conform to specified requirements.

D. Submit certification that the installers of products specified in this Section meet the qualification requirements described in Article 1.6 of this Section.

E. Submit manufacturer’s product literature and installation procedures for each type of firestop material to be installed. Literature shall indicate product characteristics, typical uses, performance and limitation criteria, and test data. Submit cured samples of firestop materials.
F. Shop drawings: Show typical installation details for the methods of installation. Indicate which firestop materials will be used where and application requirements to meet specific jobsite conditions.

G. Provide manufacturer’s Engineering Judgment (EJ) identification number and drawing details when no UL system is available for an application. Engineering Judgment shall include both project name, and name of contractor who will install the firestop system in accordance with EJ drawing. Submit Engineering Judgment to OSHPD for review and approval prior to installation.

1.5 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Materials and installation shall comply with requirements of governing regulations and authorities.

1. Comply with requirements of 2013 California Building Code, Chapter 7, “Fire and Smoke Protection Features”.

B. Firestopping systems (materials and design) shall be F-rated to meet the hourly rating of the wall or floor as tested by nationally accepted test agencies per ASTM E814 or UL 1479 in a configuration representative of field conditions. T-ratings for floors shall be as required in the 2013 CBC Chapter 7 “Fire and Smoke Protection Features”, as applicable to design conditions. L-ratings shall be tested in accordance with ANSI/UL1479 (smoke barriers) and ANSI/UL2079 (joints), such that for each 100 square feet of area, the total cumulative leakage of each firestop assembly shall not exceed 50 cubic feet per minute.

C. Unless specified and approved, no pipe insulation shall be removed; all insulation shall remain intact, continuous and undamaged when firestopped.

D. A manufacturer’s direct representative (not distributor or agent) shall be on-site prior to the initial installation of firestop systems to train appropriate Contractor personnel in proper selection and installation procedures. This shall be done per manufacturer’s written recommendations published in their literature and drawing details.

E. Firestop systems do not reestablish the structural integrity of load-bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load-bearing or shear wall assembly.

F. Firestop applications for which no UL tested system is available through an acceptable manufacturer, submit acceptable manufacturer's Engineering Judgment derived from similar UL design systems or other acceptable tests, to local authorities having jurisdiction, for review and approval prior to installation. Engineering Judgment drawings shall meet the requirements set forth by the International Firestop Council (September 7, 1994).

1.6 INSTALLER QUALIFICATIONS

A. Engage an experienced installer who is certified, licensed, and FM Approved in accordance with FM 4991, certified by UL as a Qualified Contractor, or otherwise qualified by the
firestopping manufacturer as having been provided the necessary training to install firestop products per specified requirements. A manufacturer's willingness to sell its firestopping products to Contractor or to an Installer engaged by Contractor does not confer qualification on the buyer.

1.7 DEFINITION

A. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, water and hot gases through penetrations in fire-rated wall and floor assemblies.

1.8 SYSTEM DESCRIPTION

A. Firestopping materials shall comply with ASTM E84, ASTM E119, ASTM E814, ASTM E1399, UL 263, UL 1479 and UL 2079 to achieve a fire rating as noted on Drawings.


C. Firestop all interruptions to fire rated assemblies, materials, and components.

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the project site in the manufacturer's original packaging. Clearly identify manufacturer, contents, brand name, applicable standard, lot number, UL label and mixing and installation instructions.

B. Store materials off-ground and protect against weather, condensation and damage. Immediately remove damaged or deteriorated materials from the job site.

C. All firestop materials shall be installed prior to expiration of shelf life.

D. Do not install damaged or expired materials.

1.10 SCHEDULING

A. Coordinate installation with other trades whose work may be affected or have effect.

1.11 PROJECT CONDITIONS

A. Conform to manufacturer's printed instructions for installation and, when applicable, curing in accordance with temperature and humidity. Conform to ventilation and safety requirements.

B. Do not use materials that contain flammable solvents.

C. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

D. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

E. Weather conditions:

1. Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and
product data sheet.

2. Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.

F. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide and install firestopping materials to meet applicable codes and installation requirements for each firestopping application. Products using caulking, putty, wrap strips, mortar, composite boards and/or mechanical devices shall be used as appropriate for the specific condition.

B. When caulking is used, provide and install flexible caulking materials. Cured firestop materials 1/8 inch thick shall be able to bend around a 1 inch mandrel without breaking.

C. Provide products that upon curing do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction. Latex sealants containing sodium silicate or other water soluble intumescent ingredients are not permitted.

D. Provide firestop sealants sufficiently flexible to accommodate motion such as pipe vibration, water hammer, thermal expansion and other normal building movement without damage to the seal.

E. Pipe insulation shall not be removed, cut away or otherwise interrupted through wall or floor openings. Provide products appropriately tested for the thickness and type of insulation utilized.

F. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur.

G. When mechanical cable pathways are not practical, openings within walls and floors designed to accommodate voice, data and video cabling shall be provided with re-enterable products specifically designed for retrofit.

H. Penetrants passing through fire-resistance rated floor-ceiling assemblies contained within chase wall assemblies shall be protected with products tested by being fully exposed to the fire outside of the chase wall. Systems within the UL Fire Resistance Directory that meet this criterion are identified with the words “Chase Wall Optional”.

I. Provide fire-resistive joint sealants sufficiently flexible to accommodate movement such as thermal expansion and other normal building movement without damage to the seal.

J. Provide fire-resistive joint sealants designed to accommodate a specific range of movement and tested for this purpose in accordance with a cyclic movement test criteria as outlined in UL 2079.

K. Provide penetration firestop systems subjected to an air leakage test conducted in accordance with Standard, UL 1479 for penetrations with published L-Ratings for ambient
and elevated temperatures as evidence of the ability of firestop system to restrict the movement of smoke.

L. Provide T-Rating Collar Devices tested in accordance with ASTM E814 or UL 1479 for metallic pipe penetrations requiring T-Ratings per the applicable building code.

M. Provide firestopping composed of components that are compatible with each other, the substrates forming openings and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

N. Provide components for each firestopping system that is needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance rated systems.

O. At through penetrations of fire rated assemblies, provide a firestop system with an "F" rating as determined by UL 1479 or ASTM E814 that is equal to the time rating of construction assembly.

P. At fire rated assemblies, provide a firestop system with an Assembly Rating as determined by UL 2079 that is equal to the time rating of construction assembly.

2.2 MINERAL WOOL INSULATION

A. Acceptable Manufacturers and Products:

B. Through penetrations: Provide 4 pcf mineral wool per tested system.

C. Head of wall construction gaps: Provide 4 pcf mineral wool per tested system.

D. Perimeter safing slot: Provide 4 pcf mineral wool batt insulation per tested system.

E. Accessories: Provide all accessories and anchors for installation as recommended by the manufacturer.

2.3 FIRESTOP SEALANT

A. Sealant for penetrations by noncombustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT).

B. Acceptable Manufacturers and Products:
   3. Substitutions: Under provisions of Section 01 60 00.

C. Sealant shall be a one-part intumescent latex compound. When exposed to high heat or flame, sealant shall be capable of expanding to seal off the annular spaces and voids at the joint. Expansion shall continue at temperatures greater than 230 degrees F. Sealant shall be thixotropic and suitable for caulking or troweling onto vertical and overhead surfaces. Sealant
shall be UL Classified (UL 1479) and tested in accordance with ASTM E814 requirements. Penetrations in fire rated assemblies shall be protected and sealed in accordance with CBC Chapter 7 requirements.

2.4 ELASTOMERIC FIRESTOP SEALANT

A. Sealant for openings between structurally separate sections of walls and floors. At top-of-walls.

B. Acceptable Manufacturers and Products:
   1. STI. Product: Series ES100 Elastomeric Sealant.
   4. Substitutions: Under provisions of Section 01 60 00.

C. Elastomeric sealant shall be a non-halogenated, latex-based, highly flexible caulk. The sealant shall be thixotropic for high-build application using standard caulking equipment or by troweling onto vertical surfaces or overhead. The sealant shall be UL Classified (UL 2079) and tested to the requirements of ASTM E814. Closures in fire rated assemblies shall be protected and sealed in accordance with CBC Chapter 7.

2.5 FIRESTOP PUTTY

A. Putty for penetrations by combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed flexible cable, or cable bundles and plastic pipe (closed piping systems). Clay-based products will not be allowed.

B. Acceptable Manufacturers and Products:
   1. STI. Product: SSP Putty.
   2. Substitutions: Under provisions of Section 01 60 00.

C. Putty shall be a one-part intumescent, non-hardening compound. The putty, when exposed to high heat or flame shall be capable of expanding to seal off annular spaces created. Range of continuing expansion shall be from 230 degrees F to greater than 1,000 degrees F. The putty shall be soft and pliable with aggressive adhesion. The putty shall be UL Classified (UL 1479) and tested to the requirements of ASTM E814. Penetrations in fire rated assemblies shall be protected and sealed in accordance with CBC Chapter 7.

2.6 INTUMESCENT PUTTY PAD

A. Firestop Putty Pads for Electrical Boxes: Intumescent moldable butyl-based firestop putty pad. Clay-based products will not be allowed.

B. Acceptable Manufacturers and Products:
FIRESTOPPING

2.7 FLEXIBLE FIRESTOP SPRAY

A. Firestop spray for fire-rated construction joints and other gaps.

B. Acceptable Manufacturers and Products:

1. STI. Products: AS Elastomeric Spray, or Fast Tack Elastomeric Silicone/Urethane Hybrid Spray.


3. 3M. Products: Firedam Spray and Fire Barrier Spray.

4. Substitutions: Under provisions of Section 01 60 00.

C. Spray shall be flexible, sprayable water-based coating that dries in ambient conditions to form a flexible seal that will compress/extend with the intended range of the joint. The spray shall be UL classified (UL 2079) and tested to the requirements of ASTM E1399. Closures in fire rated assemblies shall be protected and sealed in accordance with CBC Chapter 7.

2.8 FIRESTOP COLLARS

A. Collars for penetrations by combustible plastic pipe (opening piping systems).

B. Acceptable Manufacturers and Products:

1. STI. Products: SSC or LLC Firestop Collar.


4. Substitutions: Under provisions of Section 01 60 00.

C. Firestop collar shall be made of a galvanized steel housing and shall contain a section of intumescent material. The material shall be designed to expand when exposed to fire. The collars shall be UL classified (UL 1479) and tested to the requirements of ASTM E814. Closures in fire rated assemblies shall be protected and sealed in accordance with CBC Chapter 7.

2.9 FIRESTOPPING FOR LARGE OPENINGS

A. Firestopping for large size, complex penetrations made to accommodate cable trays, multiple steel and copper pipes and electrical busways in raceways.

B. Acceptable Manufacturers and Products:
1. STI. Products: SSB Firestop Pillows, CS Composite Sheet, or SSM Mortar.


3. 3M. Product: Fire Barrier CS-195+ Composite Sheet and Fire Barrier Mortar.

4. Substitutions: Under provisions of Section 01 60 00.

C. For large openings, install intumescent compound. The intumescent compound, when exposed to high heat or flame, shall be capable of expanding to seal off annular spaces created. Product shall be UL classified (UL 1479) and tested to the requirements of ASTM E814. Closures in fire rated assemblies shall be protected and sealed in accordance with CBC Chapter 7.

2.10 FIRESTOP PILLOWS

A. Pillows for large openings, self-contained intumescent product capable of expanding to seal-off openings. UL Classified, tested per UL 1479 and ASTM E814.

B. Acceptable Manufacturers and Products:

1. STI. Product: SSB Firestop Pillow.

2. 3M. Product: Fire Barrier Pillow.

3. Substitutions: Under provisions of Section 01 60 00.

2.11 INTUMESCENT WRAP

A. Intumescent Wrap: Precut wrap strips for plastic and insulated pipe penetration through rated assemblies.

B. Acceptable Manufacturers and Products:

1. STI. Products: RED2 or BLU2 Wrap Strip.


3. Substitutions: Under provisions of Section 01 60 00.

2.12 FIRE-RATED CABLE PATHWAY

A. Gangable fire-rated device modules capable of retrofit, comprised of steel raceway with intumescent foam pads allowing 0 percent to 100 percent cable fill for cable penetrations through gypsum or CMU walls, concrete floors and concrete walls.

B. Acceptable Manufacturers and Products:

1. STI. Product: EZ Path Pathway Device Series 22, 33 or 44.

2. Substitutions: Under provisions of Section 01 60 00.

2.13 FIRE-RATED HVAC RETAINING ANGLES
A. Steel angle system with integral intumescent firestop gasket for use on steel HVAC ducts.

B. Acceptable Manufacturers and Products:
   1. STI. Product: Fyre-Flange Steel Firestop Retaining Angle.
   2. Substitutions: Under provisions of Section 01610.

2.14 FIRESTOP PLUGS

A. Re-enterable, foam rubber plug impregnated with intumescent material for use in blank openings and cable sleeves.

B. Acceptable Manufacturers and Products:
   1. STI. Product: FP Firestop Plug.
   2. Substitutions: Under provisions of Section 01 60 00.

2.15 ACCESSORIES

A. Installation Accessories: Clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

PART 3 EXECUTION

3.1 CONDITIONS REQUIRING FIRESTOPPING

A. General: Provide firestopping for conditions specified whether or not firestopping is indicated and, if indicated, whether such material is designed as insulation, safing or otherwise.

B. Penetrations:
   1. Penetrations include conduit, cable wire, pipe, duct or other elements that pass through one or both outer surfaces of a fire-rated floor, wall or partition.
   2. These requirements for penetrations shall apply whether or not sleeves have been provided, and whether or not penetrations are to be equipped with escutcheons or other trim. If penetrations are sleeved, firestop annular space, if any, between sleeve and wall opening.

C. Provide firestopping to fill miscellaneous voids and openings in fire-rated construction as specified herein.

D. Provide intumescent moldable pads over backs and sides of all electrical junction and utility boxes at fire rated walls.

3.2 EXAMINATION

A. Verify openings are ready to receive the work of this Section.

3.3 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material or other matter that may affect bond of firestopping material.
B. Remove incompatible materials that may affect bond.

C. Install noncombustible backing materials to arrest liquid material leakage.

D. Examine the areas and conditions where firestops are to be installed and notify Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected by Contractor in a manner acceptable to Architect.

E. Verify penetrations are properly sized and in suitable condition for application of materials.

F. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.

G. Comply with manufacturer’s recommendations for temperature and humidity conditions before, during and after installation of firestopping.

3.4 INSTALLATION

A. General:

1. Installation of firestops shall be performed by an applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer’s detailed installation procedures. Written verification of the manufacturer’s training shall be submitted to Architect.

2. Apply firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, manufacturer’s recommendations, and listing descriptions.

3. Provide sprinkler piping with NFPA 13 required annular space using firestop to allow movement.

4. Coordinate with plumbing, mechanical, electrical and other trades to assure that all pipe, conduit, cable and other items which penetrate fire-rated construction have been permanently installed prior to installation of firestops.

5. All penetrations for pipes, conduits, tubing or other building service elements shall be installed below the head-of-wall joint such that the distance between the top of the wall and the top of the penetrant is a minimum of 3 inches, no exceptions.


C. Manufacturer’s Instructions: Comply with manufacturer’s instructions for installation of through-penetration materials.

1. Seal all holes or voids made by penetrations to ensure an air- and water-resistant seal.

2. Protect materials from damage on surfaces subjected to traffic.

D. Field Quality Control:

1. Prepare and install firestopping systems in accordance with manufacturer’s printed instructions and recommendations.
2. Follow safety procedures recommended in the Material Safety Data sheets.

3. Finish surfaces of firestopping which are to remain exposed in the completed work to a uniform and level condition.

4. All areas of work must be accessible until inspection by the applicable Code authorities.

5. Correct unacceptable firestop installations and provide additional inspection to verify compliance with this Section at no additional cost.

6. All firestop assemblies shall be identified with a permanently affixed ID label as follows:

   a. Firestop System Warning Label: Minimum 3 inch by 5 inch label, red color or with red colored type and "WARNING" written in bold type. Label shall be adhesive backed or provide other means of permanent attachment. Identified or included spaces for the following information:

      1) Name of manufacturer.
      2) Name of Installer.
      3) Date firestop system was installed.
      4) Firestop System UL number or manufacturer’s engineered design number.
      5) F Rating and T Rating as applicable.

7. All fire-rated wall assemblies shall be identified by stenciling with red paint in accessible concealed floor, floor-ceiling, or attic spaces at intervals not exceeding 30 feet and within 15 feet of the end of each wall per CBC Section 703.7. Lettering shall be not less than 3 inches in height, incorporating the appropriate wording such as: “FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS”, with the relevant hourly fire resistance rating clearly stated.

8. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.

9. Keep areas of work accessible until inspection by applicable code authorities.

10. Perform under this Section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

   E. Installation shall be completed in a neat, workmanlike manner according to manufacturer’s recommendations. Securely fasten and anchor insulation in place to prevent displacement or sagging of material. Safing insulation shall be adequately lapped.

   F. Install material at fire rated horizontal to vertical assembly closures and at fire rated walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items requiring firestopping.

   G. Apply primer and materials in accordance with manufacturer’s instructions.

   H. Apply firestopping material in sufficient thickness to achieve rating.

   I. Compress fibered material to achieve a density of forty percent of its uncompressed density.
J. Dam material to remain.

3.5 INSPECTIONS

A. Firestopping inspections shall meet the requirements of CBC Section 1705.16.

B. Inspection of completed work shall be performed by OSHPD and/or the building underwriter’s designee. If required by OSHPD or underwriter, inspections may be performed by an independent, third-party construction inspection and testing service provided that:

1. Inspections are performed to the requirements of the following standards as applicable:
   b. Service Penetrations: ASTM E2174.

2. Individual(s) performing inspection shall provide evidence of valid Errors and Omissions Insurance coverage for this service.

3. Individual(s) performing inspection shall not have any financial connection to installer, firestop manufacturer, distributor or supplier.

3.6 CLEANING

A. Clean Work under provisions of Section 01 74 00.

B. Clean adjacent surfaces of firestopping materials.

C. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.

D. Leave finished work in a neat and clean condition with no evidence of spillovers or damage to adjacent surfaces.

3.7 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01 76 00.

B. Protect adjacent surfaces from damage by material installation.

C. Where firestopping is installed at locations which will remain exposed in the completed work, provide protection as necessary to prevent damage to adjacent surfaces and finishes, and protect as necessary against damage from other construction activities.

END OF SECTION 07 84 00

07 84 00 - 13
FIRESTOPPING
SECTION 07 92 00
CAULKING AND SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Scope: Work of this Section shall include all materials and installation necessary to provide Caulking and Sealants, as shown and detailed on the drawings and specified herein.

1.2 QUALITY ASSURANCE

A. References:


B. QUALIFICATIONS:

1. General: The manufacturer of the sealant used shall have been in the business of manufacturing the specified types of such sealants for not less than ten (10) years.

2. Applicator: Installer specializing in the work of this Section with minimum five (5) years documented experience

3. Volatile Organic Compounds (VOC): Use only products in compliance with VOC content limits required by Federal and State EPA regulations.

C. Compatibility With Substrate: Verify that caulking and sealants used are compatible with joint materials.

D. Joint Tolerances: Comply with manufacturer’s joint width/depth ratio limitations.

1.3 SUBMITTALS

A. General: Refer to Section 01 33 23 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Samples: Submit manufacturer's standard colors prior to application.

C. Product Data: Submit manufacturer's specifications, data, and installation instructions for review prior to purchase or application.

D. Certificates: Submit certification that sealants proposed for use, comply with the Contract Documents.

1.4 PRODUCT HANDLING

A. General: Refer to Section 01 31 00 – COORDINATION.
B. Storage: Per manufacturer’s recommendations for proper precautions for shelf life, temperature, humidity and similar storage factors to ensure the fitness of the material when installed.

1.5 SITE CONDITIONS

A. Environmental Requirements: Do not apply materials when temperature is below 40°F, nor under extreme temperature conditions when joint openings are at maximum or minimum width.

1.6 MAINTENANCE

A. General: Refer to Section 01 77 00 – CLOSEOUT PROCEDURES.

B. Guarantee: On form provided at end of Section 01 78 00 – CLOSE OUT SUBMITTALS, provide five (5) year written guarantee commencing from date of final acceptance by University’s Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Caulking And Sealants:
   1. Manufactured by Tremco, Inc., unless otherwise noted.
   2. Pecora Chemical Corp., or equal.
   3. Color to be selected by University’s Representative.

B. Interior Joints: Acrylic Latex.

C. Joint Cleaner: Provide cleaner recommended by sealant manufacturer for specific joint surface and condition.

D. Joint Primer and Sealer: As recommended by sealant manufacturer for each condition.

E. Bond Breaker Tape: Pressure sensitive polyethylene tape.

F. Other Materials: Manufacturer's standard for items required or type best suited for intended use.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Refer to Section 01 31 00 – COORDINATION.

B. Conditions Of Work In Place:
   1. General: Carefully examine before beginning work; report defects.
   2. Substrate: Inspect surfaces to insure that no bond-breaker materials contaminate the surface to which the sealant is to adhere and to ensure that unsound substrates are repaired.
C. Preparation Of Surfaces:

1. Surfaces: Prepare joints in accordance with manufacturer's recommended instruction to ensure maximum adhesion. Prime as required, protecting adjacent exposed surfaces.

2. Sealants: Prepare sealant as required, including proper mixing of multicomponent sealants.

3.2 APPLICATION

A. General: Install in conformance with referenced standards, manufacturer's written directions, as shown, and as specified.

B. Protection: Protect surfaces adjacent to joints to receive sealant. Cover joints in walking surfaces with heavy duty, non-staining tape, until material has dried.

C. Installation:

1. General: Install sealant materials per manufacturer's instructions. Prevent three-sided adhesion. Provide sealant depth of ½ joint width; minimum depth of ¼"; maximum of ½", unless otherwise required by the manufacturer.

2. Backer Rod: Install using blunt or rounded tools to insure uniform (±¼") depth without puncturing material. Use oversize backer rod; minimum of 33% for closed cell type; minimum of 50% for open cell type, unless otherwise required by the manufacturer.

3.3 CLEANING

A. General: Upon completion, thoroughly clean exposed surfaces per manufacturer's instructions. Perform cleaning in a manner that will not affect the appearance of the sealant or the adjacent finish material.

END OF SECTION 07 92 00
DIVISION 08
NOT USED
SECTION 08 11 00
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work under this Section shall include all material and installation necessary to provide Hollow Metal Doors and Frames, as shown and detailed on the Drawings and specified herein.

1.2 QUALITY ASSURANCE

A. Labeled Doors And Frames: Conform to requirements of State Fire Marshal Standard 12-43-4 and Underwriters Laboratory. Provide label information required by Section 12-43-407, Part 12, T-24 CCR.

1. Provide labels on rated doors and frames from accepted listing services such as Underwriters Laboratore (UL) or Warnock Hersey (WH).

2. Provide re-certification for altered rated doors and frames.

B. Reference Standards:

1. Accessibility Requirements:

   a. General: Comply with requirements of the Americans with Disabilities Act.


5. National Fire Protection Association (NFPA):

Project No. M030667
Hospital Seismic Upgrade – Decommission North/South Wing

6. Underwriters Laboratories (UL):
   a. UL 10B, Fire Tests for Door Assemblies.
   b. UL 10C, Standard for Positive Pressure Fire Tests of Door Assemblies.

1.3 SUBMITTALS
   A. Shop Drawings: Submit manufacture and installation details, including fastenings, for review. Show details of each condition at 3” scale.
   B. Samples: If specifically requested.
   C. Product Data: Submit manufacturer’s specification, data, and installation instructions for review.

PART 2 - PRODUCTS

2.1 MATERIALS
   A. Steel:
      1. Sheet: ASTM A366 (CR) and A569 (HR), uncoated, pickled, and free from pits and defects. Use cold-rolled or hot-rolled for frames; stretcher-leveled for 18 gauge and lighter.
   B. Fasteners: Galvanized or cadmium plated.
      1. Bolts and Nuts: ASTM A307, Grade A.
      2. Machine Screws: FS FF-S-92, Type III cross-recessed, Design I or II recess, Style 2c flat head; carbon steel.
   C. Silencers: Resilient rubber; manufacturer's standard.
   D. Sealant: Refer to Section 07 92 00 – Caulking and Sealants.

2.2 MANUFACTURE
   A. Hardware Requirements: Prepare doors and frames at factory to receive template hardware per final schedule; locate as specified under Section 08 71 00 – Finish Hardware. Provide reinforcements of specified thicknesses and sizes recommended by hardware manufacturer; hinge reinforcements not less than 7 gauge and at least 9” long; other mortised and countersunk items not less than 12 gauge; surface applied items not less than 14 gauge.
   B. Hollow Metal Doors:
1. **General:**
   a. Interior (Non-rated): SDI-100 Grade II, Model 1.
   b. Interior (Fire Rated): SDI-100 Grade II, Model 2.

2. **Door Construction:**
   a. Face: Steel sheet in accordance with ANSI/SDI-100.
   b. Core:
      1) General: Manufacturer’s standard for following uses.
      2) Composite: For Fire rating, as shown.
      3) Thermal Insulated: Total insulation R value of 11, measured in accordance with ASTM C236.

3. **Accessories:**
   a. Fasteners: Manufacturer’s standard; tamperproof.

4. **Astragals:** ¼” x 2” steel, as shown, specifically for double doors. Secure with tamperproof bolts at 6” on center and 1” from each end.

C. **Metal Frames, Extra Heavy Duty:**
   1. Interior Frames: 16 gauge; 14 gauge for frames over 3'-0” wide or fire rated. Provide hospital stops.

D. **Finish:** Baked primer Factory baked enamel; color as selected by the University’s Representative.

2.3 **FABRICATION**

A. **Metal Doors:**
   1. **Types:**
      a. Flush Doors: Fabricate doors with hardware reinforcement welded in place.
      b. Flush Panels: Fabricate as specified for flush doors. Prepare panels for concealed support and anchorage.
   2. **Fire Rated Doors:** Permanently attach fire-rating label to each door unit.
   3. **Reinforce doors for hardware per ANSI/SDI A250.6, except for the following changes:**
      a. Hinges: Steel plate 3/16 inch thick by 1-1/2 inches wide by 6 inches longer than hinge; secured by not less than six spot welds.
      b. Surface Applied Closers: 12 gauge sheet steel; secured with not less
4. Door Clearances: Provide \( \frac{3}{8}'' \) maximum clearance at jambs, heads, and meeting stiles; threshold clearances as specified under Section 08 71 00 - FINISH HARDWARE.

5. Electrical Requirements: Make provisions for installation of electrical items specified in Section 08 71 00 - FINISH HARDWARE and other applicable Sections.

B. Metal Frames:

1. Type:
   a. Standard Frames: Fabricate frames as a fully welded unit.
   b. Provide mortar boxes for all hardware.

2. Fire Rated Frames: Fabricate as specified for standard metal frames permanently attach fire-rating label to frame.

3. Reinforcement:
   a. General: Reinforce frames wider than 48” with roll-formed steel channels fitted tightly into frame head, flush with top.
   b. Hardware: Fabricate frames with reinforcing plates welded in place. Provide mortar guard boxes, where required.

4. Stops:
   a. Applied Stops: Rolled steel shape, mitered corners, prepared for countersink style tamper proof screws. Provide replaceable closed-cell sponge neoprene gasket, thickness as recommended by manufacturer.
   b. Hospital Type: Terminate doorstops 6” above finished floor. Cut stop at 45º angle and close.

5. Silencers:
   a. Single Doors and Mullions of Double Doors: Provide three (3) single silencers equally spaced on strike side.
   b. Frame Head at Double Doors without Mullions: Provide two (2) single silencers equally spaced.

C. Anchors:

1. General: Fabricate 16 gauge x 2” wide anchors of same material used for door frames.

2. Metal Stud Partitions: Metal stud and floor type anchors.
PART 3 - EXECUTION

3.1 PREPARATION

A. General: Refer to Division 1, Section 01 31 00 – Coordination. Verify that opening sizes and tolerances are acceptable.

3.2 INSTALLATION

A. General: Install in strict conformance with referenced standards, the manufacturer's written directions, as shown, and as herein specified.

B. Fire Rated Openings: As shown; make manufacturer's installation instructions available to inspecting authorities.

C. Anchors:

   1. Jambs:
      a. General: Position one (1) anchor above top butt reinforcement and one (1) anchor below bottom butt reinforcement; minimum four (4) anchors per doorjamb, 24" on center maximum.
      b. Fasten jambs to concrete floors with 3/8 inch Hilti KB TZ expansion anchor. Minimum 1 anchor per doorjamb.
      c. Frames Set in Metal Stud Partitions:
         1) General: Weld to frames and studs. Field welding of rated door frame anchors shall be performed only by certified personnel.
         2) 25 gauge Studs: Fasten to studs with sheet metal screws per anchor manufacturer's recommendations.
   2. Head: Provide minimum of two (2) anchors at frames over 2'-6" wide; 24" on center, maximum.

D. Metal Frames:

   1. General: Set frames plumb, straight and square; align and securely brace until permanent anchors are set; use shims where required. Remove temporary braces after wall construction is completed.
   2. Door Frames:
      a. Standard Frames: Where shown, provide overhead frame bracing; securely anchor to structure. Install roll-formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.
      b. Drywall Frames: As shown; per manufacturer's instructions.

E. Metal Doors:
1. General: Match doors into their respective frames; install plumb, straight and square.

2. Hardware: Per Section 08 71 00 – FINISH HARDWARE.

3. Maximum Diagonal Distortion: \( \frac{1}{8}'' \) measured with straight-edge, corner to corner.

F. Finish: Touch-up factory applied finish.

3.3 ADJUSTMENTS

A. General: Prior to acceptance, adjust moveable parts to assure smooth operation.

3.4 CLEANING

A. General: Upon completion, thoroughly clean exposed surfaces per manufacturer's instructions.

END OF SECTION 08 11 00
PART 1 - GENERAL

1.1 DESCRIPTION
A. Scope: Work under this Section shall include all materials and installation necessary to provide Access Doors as shown and detailed on the Drawings and specified herein.

1.2 QUALITY ASSURANCE
A. Reference Standards:
   2. Underwriters Laboratories (UL): Fire tests.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Access Doors:
   1. Steel frame with continuous hinge, manufactured by Milcor, Inc.; sizes as shown, J.L. Industries, or equal.
B. Fire Rated Openings:
   1. General: "Fire Rated" type with flush face key operated mortise cylinder lock and interior latch release mechanism; Warnock-Hersey 3-hr rating.
C. Fasteners: As recommended by manufacturer.
D. Finish: Polyester powdercoat finish, color as selected by Architect.

PART 3 - EXECUTION

3.1 PREPARATION
A. Measurements General: Install in conformance with referenced standards, manufacturer’s written directions, as shown, and as specified.
B. General: Take field measurements; report variance between plan and field dimensions.

3.2 ADJUSTMENT
A. General: Prior to acceptance, adjust moveable parts to assure smooth operation.
3.3 CLEANING

A. Upon completion, thoroughly clean exposed surfaces per manufacturer's instructions.

END OF SECTION 08 31 00
DIVISION 09
FINISHES
PART 1 - GENERAL

1.1 DESCRIPTION
   A. Scope: Work under this Section shall include all materials and installation for Metal Stud System, as shown and detailed on the drawings and specified herein.
   B. Related Work Specified Elsewhere:
      1. Section 09 23 00 – GYPSUM PLASTER.
      2. Section 09 29 00 – GYPSUM BOARD

1.2 SUBMITTALS
   A. General: Refer to Section 01 33 23 – SHOP DRAWINGS, PRODUCT DATA & SAMPLES.
   B. Product Data: Submit manufacturer’s specification, data, and installation instructions

1.3 PRODUCT HANDLING
   A. General: Refer to Section 01 31 00 – COORDINATION.

1.4 MAINTENANCE
   A. General: Refer to Section 01 77 00 – CLOSEOUT PROCEDURES.
   B. Guarantee: Provide in required form for a period of one (1) year from date of final acceptance by University.

PART 2 - PRODUCTS

2.1 MATERIALS
   A. Metal stud framing members consisting of: C-track for floor runners, headers and sills, wall studs and slotted track for top track runners.
      1. Manufacturers: Unimast, Inc., Gold Bond Building Products Division of the National Gypsum Corp., or equal, no known equal.
   B. Stud Types:
      1. General: Provide types designed for screw application of gypsum wallboard. Stud fabricated by manufacture that belongs to the Steel Stud Manufacturers Association (SSMA) meeting requirements of the International Code Council (ICC) \textit{ESR-3064P} #4943P.
      2. Metal Studs: ASTM C645, non-load bearing type with punched webs; roll-formed electro-galvanized steel sheet in the following gage:
**METAL STUD SYSTEM**

01/10 Edition; Rev. 2 (03-08-2012)

20ga typical framing unless noted otherwise on drawings.

16ga for king and trimmer studs at door/window openings and wing wall ends. Studs widths as shown on the drawings.

C. Miscellaneous Framing:

1. Furring:
   a) 25ga electro-galvanized steel sheet, roll-formed, HAT: 2-¾” x ¾” deep with ½” wide flanges.
   b) Zee: 1-½” x 1-½”.
   c) 25ga electro-galvanized sheet, roll-formed. Resilient RC channels.

2. Floor runners or C-Track: 20ga Un-punched track.

3. Top Runner or Slotted Track: 20ga deep leg punched track: SLP-TRK, or equal.

4. Stud Stiffeners: ¾” cold rolled steel weighing not less than 300 lbs. per 1000 lineal feet; rust-inhibitive coated.

5. Channels: 2-½” cold rolled steel weighing not less than 300 lbs. per 1000 lineal feet; rust inhibitive coated.

6. Backing Plates: 16ga C-track or plate. Sizes and types as shown on drawings.

D. FASTENERS:


2. Powder Driven Fasteners:
   a. Hilti, Inc.; DS32P10 4.5mm diameter, 32mm shank carbon steel, zinc plated. Used with DX76.
   b. Ramset, or equal with current ICC ES report.

3. Screws: Type S bugle head; sizes recommended by gypsum board manufacturer.
E. Wire Hangers: 12 gage galvanized soft steel wire.

F. Neoprene Tape: ASTM D1056, Grade SCE41, soft sponge neoprene with adhesive one side; black; $\frac{1}{4}$" x $\frac{1}{2}$", unless otherwise shown.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Refer to Section 01 31 00 – COORDINATION.

B. Examination: Examine conditions of work in place before beginning work; report defects.

C. Measurements: Take field measurements; report variance between plan and field dimensions.

3.2 INSTALLATION

A. Metal Framing:


2. Structural Studs: MLSFA (Metal Lath/Steel Framing Association).

B. Metal Stud Partitions:


2. Floor Runners: Secure with $\frac{3}{8}$" diameter expansion bolts or powder driven fasteners at least 1" long, where permitted by code. Space fasteners 4" from ends of each piece; maximum 16" on center intermediate; minimum of 2 fasteners per piece of runner.

3. Ceiling Runners/tracks: Fasten to Wide Flange or Concrete Deck with powder driven fasteners per manufacturer’s recommendations.

4. Studs: Gages, depths, and spacing shown. Where not shown, provide per stud manufacturer’s recommendations.

5. Stiffeners: 2 rows at third points for studs with finish one side only; one row at midpoint for studs with finish both sides. Snap into punched web of each stud; nest laps and wire tie.

C. Backing Plates: Install at all casework, cabinets; grab bars and other equipment requiring attachment to walls or partitions. Attach to metal studs by welds or sheet metal screws as applicable.

3.3 CLEANING

A. See Section 01 74 00 – CLEANING.

END OF SECTION 09 22 16
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work under this Section shall include all materials and installation for Portland Cement Plaster (Stucco) siding as shown and detailed on the drawings and specified herein.

1.2 SUMMARY

A. This Section includes the following:

1. Metal framing and furring
2. Metal lath and accessories
3. Plastic accessories
4. Portland cement plaster
5. Stucco finishes

1.3 SUBMITTALS

A. General: See Section 01 33 23 – Shop Drawings, Product Data and Samples.

B. Product Data for each product specified.

C. Samples for initial selection in the form of manufacturer's color charts consisting of actual units or sections of units at least 12" square showing the full range of colors, textures, and patterns available for each type of finish indicated.

1. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.

2. Include similar Samples of material for joints and accessories involving color selection.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver cementitious materials to Project site in original packages, containers, or bundles, labeled with manufacturer's name, product brand name, and lot number.

B. Store materials inside, under cover, and dry, protected from weather, direct sunlight, surface contamination, aging, corrosion, and damage from construction traffic and other causes.
1.5 PROJECT CONDITIONS

A. Environmental Requirements, General: Comply with requirements of referenced plaster application standards and recommendations of plaster manufacturer for environmental conditions before, during, and after plaster application.

B. Warm-Weather Requirements: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and cure plaster as required by climatic and job conditions to prevent dry out during cure period. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these, as required.

C. Exterior Plaster Work: Do not apply plaster when ambient temperature is below 40°F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Metal Framing and Supports shall be by California Expanded Metal Products Co., Consolidated Systems, Inc., Western Metal Lath Co. or equal.

2. Expanded-Metal Lath shall be by California Expanded Metal Products Co., United States Gypsum Co., Western Metal Lath Co., or equal

3. Wire-Fabric Lath shall be by Davis Wire Corporation, Keystone Steel & Wire Co., K-Lath Building Products, or equal

4. Metal Accessories shall be by California Expanded Metal Products Co., Stockton Products, Western Metal Lath Co., or equal

5. Plastic Accessories shall be by Alabama Metal Industries Corp. (AMICO), Plastic Components, Inc., Vinyl Corp., or equal

6. Stucco shall be by California Stucco Products Corp., Highland Stucco, United States Gypsum Co., or equal

2.2 VERTICAL METAL FURRING

A. General: Provide vertical furring complying with the following requirements:


B. Channel Furring and Braces: Cold-rolled steel, minimum 0.0598" thick base (uncoated) metal and ¾" deep-by-7/16" wide flanges, 300 lb/1000 feet.

C. Hat Channels: Hat-shaped screwable furring channels, 7/8" deep, formed from zinc-coated (galvanized) steel sheet, minimum 0.0179" thick, Grade 33.

D. Z-Furring Members: Manufacturer's standard screw-type Z-shaped furring members formed from minimum 0.0179" thick, zinc-coated (galvanized) steel sheet designed for mechanical attachment of insulation boards or blankets to monolithic concrete and masonry walls.
E. Furring Brackets: Serrated-arm type, minimum 0.0329" thick base (uncoated) metal, adjustable from ¼" to 2-¼" wall clearance for channel furring.

2.3 LATH

A. Expanded-Metal Lath: Comply with ASTM C 847 for material, type, configuration, and other characteristics indicated below.

1. Material: Fabricate expanded-metal lath from sheet metal conforming to the following:
   a. Galvanized Steel: Structural-quality, zinc-coated (galvanized) steel sheet complying with ASTM A 653, G60 minimum coating designation, unless otherwise indicated.

2. Diamond-Mesh Lath: Comply with the following requirements:
   a. Configuration: Flat.
      1) Weight: 2.5 lb/sq. yd.
      2) Weight: 3.4 lb/sq. yd.

B. Paper Backing: Where paper-backed lath is indicated, provide the following material factory bonded to back of lath. Comply with FS UU-B-790, Type-I, grade and style as indicated below:


2.4 ACCESSORIES

A. General: Comply with material provisions of ASTM C 1063 and the requirements indicated below; coordinate depth of accessories with thicknesses and number of plaster coats required.

1. Aluminum Components: Alloy, temper, and finish recommended by manufacturer with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 for alloy and temper 6063-T5.

2. Galvanized Steel Components: Fabricated from zinc-coated (galvanized) steel sheet complying with ASTM A 653, G40 minimum coating designation.


B. Metal Corner Reinforcement: Expanded, large-mesh, diamond-metal lath fabricated from zinc-alloy or welded-wire mesh fabricated from 0.0475" diameter, zinc-coated (galvanized) wire and specially formed to reinforce external corners of Portland cement plaster on exterior exposures while allowing full plaster encasement.
C. Cornerbeads: Small nose cornerbeads fabricated from the following metal, with expanded flanges of large-mesh diamond-metal lath allowing full plaster encasement.

1. Galvanized Steel: Minimum 0.0172" thick.
2. Aluminum: Minimum 0.050" thick.

D. Control Joints: Prefabricated, of material and type indicated below:

1. Galvanized Steel: Minimum 0.0172" thick.
2. Aluminum: Minimum 0.050" thick.
   a. Provide removable protective tape on plaster face of control joints.

E. Lath Attachment Devices: Material and type required by ASTM C 1063 for installations indicated.

2.5 PLASTER MATERIALS

A. Base-Coat Cements: Type as indicated below:

1. Portland cement, ASTM C 150, Type I.

B. Job-Mixed Finish-Cat Cement: Material and color as indicated below:

1. Portland cement, ASTM C 150, Type I.

C. Cement Color: Provide color selected by University's Representative from manufacturer's full range of colors.

D. Stucco Finish Coat: Manufacturer's standard factory-packaged stucco, including Portland cement, aggregate, coloring agent, and other proprietary ingredients.

1. Color as indicated, manufacturer's standard product consisting of white or gray cement combined with colorfast mineral pigments and aggregates selected for color.
2. Provide color selected by University's Representative from manufacturer's full range of colors.

E. Asphalt-Saturated Felt: ASTM D 226, Type I (No. 15), nonperforated.

F. Line Wire: 0.0475" diameter, zinc-coated (galvanized), soft, annealed steel wire.

G. Steel drill screws complying with ASTM C 1002 for fastening metal lath to wood or steel members less than 0.033" thick.

1. Extruded-Polystyrene Board Insulation: Rigid, cellular, polystyrene thermal insulation formed from a polystyrene base resin by an extrusion process using hydro chlorofluorocarbons as the blowing agent to comply with ASTM C 578 for Type IV, and with the following surface-burning characteristics:
2.6 PLASTER MIXES AND COMPOSITIONS

A. General: Comply with ASTM C 926 for base- and finish-coat mixes as applicable to plaster bases, materials, and other requirements indicated.

B. Base-Coat Mixes and Compositions: Proportion materials for respective base coats in parts by volume per sum of cementitious materials for aggregates to comply with the following requirements for each method of application and plaster base indicated. Adjust mix proportions below within limits specified to attain workability.

C. Fiber Content: Add fiber to following mixes after ingredients have mixed at least 2 minutes. Comply with fiber manufacturer's written instructions but do not exceed 1 lb/cu. ft of cementitious materials. Reduce aggregate quantities accordingly to maintain workability.

D. Three-Coat Work over Metal Lath: Base-coat proportions as indicated below:

1. Scratch Coat: 1 part Portland cement, 0 to ¾ parts lime, 2-½ to 4 parts aggregate.

2. Brown Coat: 1 part Portland cement, 0 to ¾ parts lime, 3 to 5 parts aggregate.

E. Job-Mixed Finish Coats: Proportion materials for finish coats in parts by volume for cementitious materials and parts by volume per sum of cementitious materials to comply with the following requirements:

F. Factory-Prepared Finish Coats: Add water only; comply with finish coat manufacturer's written instructions.

1. Stucco Finish Coat: Add water only; comply with stucco manufacturer's written instructions.

2.7 MIXING

A. Mechanically mix cementitious and aggregate materials for plasters to comply with applicable referenced application standard and with recommendations of plaster manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION OF LATH AND FURRING, GENERAL


B. Install supplementary framing, blocking, and bracing at terminations in work and for support of fixtures, equipment services, heavy trim, grab bars, handrails, furnishings, and similar work to comply with details indicated or, if not otherwise indicated, to comply with applicable written instructions of lath and furring manufacturer.

C. Isolation: Where lathing and metal support system abuts building structure horizontally and where partition or wall abuts overhead structure, sufficiently isolate from structural movement to prevent transfer of loading from building structure. Install slip- or cushion-type joints to absorb deflections but maintain lateral support.
1. Frame both sides of control joints independently and do not bridge joints with furring and lathing or accessories.

D. Install additional framing, furring, runners, lath, and beads, as required to form openings and frames for other work as indicated. Coordinate support system for proper support of framed work that is not indicated to be supported independently of metal furring and lathing system.

1. Extend and attach partition support systems to structure above suspended ceilings, unless

3.2 INSTALLATION OF VERTICAL METAL FURRING

A. Install vertical metal furring components of sizes and spacings indicated, but not in smaller sizes or greater spacings than those required by referenced ML/SFA standard.

B. Metal Furring to Receive Metal Lath: Comply with requirements of ML/SFA 920, "Guide Specifications for Metal Lathing and Furring," applicable to each installation condition indicated.

3.3 LATHING

A. Install metal lath for the following applications where plaster base coats are required. Provide appropriate type, configuration, and weight of metal lath selected from materials indicated that comply with referenced ML/SFA specifications and ASTM lathing installation standards.

1. Exterior sheathed wall surfaces using 3.4-lb/sq. yd. minimum weight, self-furring, diamond-mesh lath.

3.4 PREPARATIONS FOR PLASTERING

A. Clean plaster bases and substrates for direct application of plaster, removing loose material and substances that may impair the Work.

B. Surface Conditioning: Immediately before plastering, dampen concrete and concrete unit masonry surfaces that are indicated for direct plaster application, except where a bonding agent has been applied. Determine and apply amount of moisture and degree of saturation that will result in optimum suction for plastering.

3.5 INSTALLATION OF PLASTERING ACCESSORIES

A. General: Comply with referenced lathing and furring installation standards for provision and location of plaster accessories of type indicated. Miter or cope accessories at corners; install with tight joints and in alignment. Attach accessories securely to plaster bases to hold accessories in place and in alignment during plastering. Install accessories of type indicated at following locations:

1. External Corners: Install corner reinforcement at external corners.

2. Terminations of Plaster: Install casing beads, unless otherwise indicated.
3. Control Joints: Install at locations indicated or, if not indicated, at locations complying with the following criteria and approved by University’s Representative:

a. Where an expansion or contraction joint occurs in surface of construction directly behind plaster membrane.

b. Distance between Control Joints: Not to exceed 18’ in either direction or a length-to-width ratio of 2-½ to 1.

c. Wall Areas: Not more than 144 sq. ft.

d. Horizontal Surfaces: Not more than 100 sq. ft. in area.

e. Where plaster panel sizes or dimensions change, extend joints full width or height of plaster membrane.

3.6 PLASTER APPLICATION

A. Plaster Application Standard: Apply plaster materials, composition, and mixes to comply with ASTM C 926.

B. Do not use materials that are frozen, caked, lumpy, dirty, or contaminated by foreign materials.

C. Do not use excessive water in mixing and applying plaster materials.

D. Flat Surface Tolerances: Do not deviate more than plus or minus ⅝” in 10’ from a true plane in finished plaster surfaces, as measured by a 10’ straightedge placed at any location on surface.

E. Grout hollow-metal frames, bases, and similar work occurring in plastered areas, with base-coat plaster material, and before lathing where necessary. Except where full grouting is indicated or required for fire-resistance rating, grout at least 6” at each jamb anchor.

F. Sequence plaster application with installation and protection of other work so that neither will be damaged by installation of other.

G. Corners: Make internal corners and angles square; finish external corners flush with cornerbeads on interior work, square and true with plaster faces on exterior work.

H. Number of Coats: Apply plaster of composition indicated, to comply with the following requirements:

1. Three Coats: Over the following plaster base:

   a. Metal lath.

   b. Finish Coats: Apply finish coats to comply with the following requirements:
2. Float Finish: Apply finish coat to a minimum thickness of $\frac{3}{4}$" to completely cover base coat, uniformly floated to a true even plane with fine-textured finish matching University's Representatives sample.

3. Prepared Finish: Apply stucco finish coats, according to manufacturer's written instructions.

I. Moist-cure plaster base and finish coats to comply with ASTM C 926, including written instructions for time between coats and curing in "Annex A2 Design Considerations."

3.7 CUTTING AND PATCHING

A. Cut, patch, replace, repair, and point up plaster as necessary to accommodate other work. Repair cracks and indented surfaces. Point-up finish plaster surfaces around items that are built into or penetrate plaster surfaces. Repair or replace work to eliminate blisters, buckles, check cracking, dry outs, efflorescence, excessive pinholes, and similar defects. Repair or replace work as necessary to comply with required visual effects.

3.8 CLEANING AND PROTECTING

A. Remove temporary covering and other provisions made to minimize spattering of plaster on other work. Promptly remove plaster from doorframes, windows, and other surfaces not to be plastered. Repair surfaces stained, marred or otherwise damaged during plastering work. When plastering work is completed, remove unused materials, containers, equipment, and plaster debris.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensure plaster work is without damage or deterioration at the time of Substantial Completion.

END OF SECTION 09 24 00
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work under this Section includes all materials and installation necessary to provide Gypsum Board as shown and detailed on the drawings and specified herein.

B. Related Work Specified Elsewhere:
   1. Section 09 22 16 – METAL STUD SYSTEM
   2. Section 09 91 00 – PAINTING

1.2 QUALITY ASSURANCE

A. References:
   1. Gypsum Association (GA):
      a. GA-216: Recommended Specifications for the Application and Finishing of Gypsum Board.

B. Qualifications: Installer specializing in the work of this Section with minimum three (3) years documented experience.

1.3 SUBMITTALS

A. General: Refer to Section 01 33 23 – Shop Drawings, Product Data and Samples.

B. Samples: If specifically requested.

C. Product Data: None required for specified products; required for alternate products.

1.4 PRODUCT HANDLING

A. General: Refer to Division 1, Section 01 31 00 – Coordination.

1.5 SITE CONDITIONS

A. Environmental Requirements: Do not install wallboard or joint compounds if building temperature is below 55°F. Provide proper ventilation to eliminate excessive moisture from building.

B. Protection: Avoid exposure to weather; use protective covering. Protect from soiling and construction damage. Water stained gypsum board sheets shall not be installed. Installed water stained gypsum board sheets will be removed and replaced at Contractor’s expense.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacture:
   1. United States Gypsum Co.
   2. Gold Bond Building Products Division of the National Gypsum Corp.
   3. Or equal.

B. Gypsum Wallboard:
   1. General: ASTM C36; tapered edge where joint finish is required; ⅛” thickness, unless otherwise shown.
   2. Water-resistant: ASTM C630; use for walls in toilets only.
   3. Corner Beads And Casing: Galvanized steel, Dur-A-Bead No. 103 at exterior corners and No. 200B L-shaped casing without back flange, or equal.

C. Joint System Materials:
   2. Tape: Perf-A-Tape reinforcement, or equal.
   3. Joint Compound shall be USG or Hamilton Joint Compound - Taping, or equal.
   4. Joint Finishing Compound shall be USG or Hamilton Joint Compound – Topping.
   5. Or equal.

D. Texture: Level 4 or better finish.

E. Interior Wall Sealant:
   1. Acoustical Sealant as manufactured by Tremco, Inc.
   2. Pecora Corp.
   3. Or equal.

F. Fasteners:

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Refer to Division 01, Section 01 31 00 – Coordination.
B. Examination: Examine conditions of work in place before beginning work; report defects.

C. Measurements: Take field measurements; report variance between plan and field dimensions.

3.2 INSTALLATION

A. General: Install in strict conformance with ASTM C840, other referenced standards, the manufacturer’s written directions, as shown, and as herein specified.

B. Gypsum Wallboard:

1. Sheet Arrangement Layout:
   a. General: Install as shown; use long sheets to restrict joints to minimum.
   b. Gypsum Sheathing: Apply horizontally; fasten 8” on center on each bearing point.

2. Cutting and Scribing: Cut neatly to fit around outlets, switch boxes and other protrusions.

3. Joints: Butt sheets loosely together with tapered edges placed together; butt edges placed next to tapered edges are not acceptable. Sand or kerf cut edges and mill ends to provide smooth jointing on exposed face. Stagger end joints. Shim wallboard as required to provide even joints, without offsets.

4. Fasteners:
   a. General: Place not less than 3/8” from edges of board, with heads dimpled slightly below surface; do not cut through paper.
   b. Ceilings, Non-rated: screws, 12” on center.
   c. Walls, Non-rated: screws, 12” on center.

5. Resilient Metal Clips: Fasten to wall at 24” on center. Position clips 4” off floor and ceiling, and spaced not more than 24” on center. Apply gypsum board with 1” long Type S screws at 12” on center, with horizontal abutting edges centered over clips.

6. Trim: Place control joints consistent with lines of building; corner beads at exterior corners; and casing beads where wallboard abuts other materials, and as shown.

7. Interior Wall Sealant: Install double bead of sealant at floor, wall intersections, where walls abut other materials, electrical boxes and any other penetrations of interior partitions.

8. Partitions: Place boards with long dimensions either vertical or horizontal on studs; stagger vertical joints on opposite sides of partitions; keep end joints to minimum. Locate joints a minimum of 12” from jambs of openings.

9. Ceilings: Install boards with long dimension at right angles to supports; end joints, perimeter of ceiling and edge of openings over solid bearing members.
C. Finishing:

1. General: Finish joints, fastener depressions, applied metal trim and surface blemishes per manufacturer's directions.

2. Finished Wallboard: Sand as necessary to provide flat, smooth surface ready for decoration.

3. Concealed Wallboard: Wallboard covered by panels or wall-fastened casework, and wallboard above level of finished ceiling, does need to be sanded smooth.

4. Textured Surfaces: Level 4 or better finish.

3.3 CLEANING

A. See Division 1, Section 01 74 00 – Cleaning

B. Keep premises free from accumulation of waste and rubbish. At the completion of work remove surplus materials, rubbish, and debris from the site.

END OF SECTION 09 29 00
SECTION 09 30 00
CERAMIC TILE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Description of the requirements for materials and installation of ceramic tile and associated accessory items, as indicated on Drawings and necessary to provide a complete and proper installation.

B. Related Sections:
   1. Section 07 92 00 – Caulking and Sealants, except as included herein.
   2. Section 09 29 00 – Gypsum Board (wall substrate).
   3. Section 10 28 00 – Toilet and Bath Accessories.

1.2 QUALITY ASSURANCE

A. Standards of Manufacture: Specific reference to manufacturer’s names and products specified herein are used as standards, but this implies no right to substitute other materials or methods without written acceptance of Architect. Refer to the General Conditions for procedures governing substitutions.
   1. Provide all like products of this Section from a single manufacturer.

B. Installer Qualifications: Installation shall be done only by installation firm normally engaged in this business. Work shall be performed by qualified installers working under an experienced supervisor.

C. References and Standards (latest Edition unless noted otherwise):
   4. American national Standards Institute, (ANSI):
      a. A108.5 – “Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar”.
      c. A118.01 – “Dry-Set Portland Cement Mortar”.
      d. A118.6 – “Ceramic Tile Grout”.
      e. A137.01 – “Specifications for Ceramic Tile”.
D. Design Criteria: Tile work shall be clean and durable; no discolored or crumbling joints, loose tile, or cracks shall develop. Correct to the University’s satisfaction above conditions which occur within warranty period.

1.3 SUBMITTALS

A. Submit the following:

1. List of materials: Complete listing of all materials proposed for use, with manufacturer’s data. Indicate location of each.

2. Manufacturer’s "Master Grade Certificate" bearing Tile Council of America (TCA) certification mark for each type of tile.

3. Samples:
   a. Samples for Initial Selection Purposes: Submit manufacturer’s color charts consisting of actual tiles or sections of tile showing full range of colors, textures and patterns available for each type of tile indicated. Include samples of grout and accessories involving color selection.
   b. Samples for Verification Purposes. Submit the following:
      1) Samples for each type of tile and for each color and texture required, not less than 12” square, on plywood or hardboard backing and grouted.
      2) Full size samples for each type of trim, accessory and for each color.

4. Certified Test Reports: Submit certified test reports from a qualified independent testing laboratory evidencing compliance of tile and tile setting products with requirements specified based on comprehensive testing of current products. Include in reports testing laboratory’s interpretation of test results relative to specified requirements.

5. Manufacturer’s maintenance instructions and recommendations for maintaining ceramic tile.

6. Maintenance Materials:
   a. Prior to final inspection, furnish the University with two percent of total quantity of each type and color of tile and grout used.
   b. Provide in either unopened manufacturer’s cartons or dustproof packaging plainly marked with type, color, and quantity of contents.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Prevent damage or contamination to materials by water, freezing, foreign matter or other causes.

B. Ensure timely delivery so products will be available at Project site when required for installation so as not to delay job progress.
1.5 JOB CONDITIONS

A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer’s recommendations.

B. Maintain temperature at not less than 50°F (10°C) in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer’s instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, tile manufacturers offering products which may be incorporated in the work include, but are not limited to, manufacturer’s identified in tile types, sizes, colors and patterns listed on the Drawings, and manufacturers of mortar, grout, and tile cleaners as follows:


2.2 MATERIALS

A. Requirements:

1. ANSI Standard for Ceramic Tile: Comply with ANSI A137.01 “American National Standard Specifications for Ceramic Tile” for types and grades of tile indicated.
   a. Furnish tile complying with “Standard Grade” requirements unless otherwise indicated.

2. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.

3. Colors, Textures and Patterns: For tile, grout and other products requiring selection of colors, surface textures or other appearance characteristics, provide products to match characteristics indicated or, if not otherwise indicated, as selected by Architect from manufacturer’s standards.
   a. Provide tile trim and accessories which match color and finish of adjoining flat tile.

4. Mounting: Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer unless another mounting method is indicated.

B. Floor Tile: Daltile Keystones Series, 2 inches x 2 inches, color as selected by Architect.
C. Wall Tile: Daltile Semi-Gloss Series glazed wall tile, 4-1/4 inches x 4-1/4 inches, color as selected by Architect.

D. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with following requirements:

1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile, where applicable.

2. Shapes: As follows, selected from manufacturer’s standard shapes:
   b. External Corners for Thinset Installations: Surface bullnose.
   c. Internal Corners: Field-butted square corners, except use coved base and cap angle pieces designed to member with stretcher shapes.
   d. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finished of different thickness, tapered to provide a reduction in thickness from ½” to ¼” across nominal 4” dimension.

E. Crack Isolation Membrane: Trowel applied or self-adhering sheet membrane; load bearing; bonded; conforming to ANSI A118.12.

   1. Products:
      a. Custom Building Products Fracture Free.
      b. Laticrete Blue 92.

F. Setting Materials: Provide materials to comply with referenced standards; as required for installation method designated.

G. Grouting Materials: Provide Commercial Portland Cement Grout; complying with ANSI A118.6; of color selected by Architect.

H. Tile Cleaner: Product specifically acceptable to manufacturer of tile and gout manufacturer for application indicated and as recommended by National Tile Promotion Federation or Ceramic Tile Institute.

I. Grout Sealer: Water-based sealer for cementitious sanded and unsanded grout joints. Resists water, oil and acid-based contaminants. Allows moisture vapor transmission. Product: SealersChoice Gold manufactured by Aqua Mix, Inc., Easy Care Grout Shield by Easy Care Products, or accepted equal.

2.3 MIXING MORTARS AND GROUT

A. Mix mortars and gouts to comply with requirements of referenced standards and manufacturers for accurately proportioning of materials, water or additive content, mixing
equipment and mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and gouts of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive tile work and conditions under which tile will be installed. Do not proceed with tile work until surfaces and conditions comply with requirements indicated in referenced tile installation standard.

3.2 INSTALLATION GENERAL

A. ANSI Tile Installation Standard: Comply with applicable parts of ANSI 108 series of tile installation standards included under “American National Standard Specifications for the Installation of Ceramic Tile”.

B. TCA Installation Guidelines: TCA “Handbook for Ceramic Tile Installation”; comply with TCA installation methods indicated or, if not otherwise indicated, as applicable to installation conditions shown.

C. Extend tile work into recesses and under or behind equipment and fixtures, to form a complete covering without interruptions, except as otherwise shown. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures and other penetrations so that plates, collars, or covers overlap tile.

E. Jointing Pattern: Unless otherwise show, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise shown.

1. For tile mounted in sheets make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.

F. Expansion Joints: Locate expansion joints and other sealant filled joints, including control, contraction and isolation joints, where indicated. Do not saw cut joints.

1. Prepare joints and apply sealants to comply with requirements of referenced standards and sealant manufacturer.

G. Grout tile to comply with the requirements of the following installation standards:

1. For ceramic tile grouts (sand-portland cement, dry-set, commercial portland cement, and latex-portland cement grouts) comply with ANSI A108.010.

3.3 TILE INSTALLATION

A. Install types of tile designated for wall and floor application to comply with ANSI Specifications for ceramic tile.
B. Install tile in compliance with TCNA methods as follows:

2. Floor Tile: TCNA Method F125-Full.

C. Apply grout sealer per manufacturer’s recommendations.

3.4 CLEANING AND PROTECTION

A. Cleaning: Upon completion of placement and grouting, clean ceramic tile surfaces so they are free of foreign matter.

1. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer’s printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective tile work.

C. Protection: When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage and wear.

1. Prohibit foot and wheel traffic from using tiled floors for at least 7 days after grouting is completed.
2. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09 30 00
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work under this Section includes all materials and installation necessary to provide Acoustical Ceilings, as shown and detailed on the drawing and specified herein.

B. Related Work Specified Elsewhere:
   1. Division 23 – MECHANICAL WORK: Air grilles and Diffusers.
   2. Division 26 – ELECTRICAL WORK: Light Fixtures.

1.2 QUALITY ASSURANCE

A. References:
   1. General: Provide completely designed system complying with requirements of UBC Standard 47-18 as modified by Section 4701(e) of CBC and specified herein.
   4. AC 368: Acceptable Criteria for Suspended Ceiling Framing Systems
   5. 2013 California Building Code

B. Qualifications: Installer specializing in the work of this Section with minimum three (3) years documented experience.

1.3 SUBMITTALS

A. General: Refer to Section 01 33 23 – Shop Drawings, Product Data and Samples.

B. Shop Drawings: Submit shop drawings showing suspension system details and reflected ceiling plans indicating location of light fixtures, mechanical air supply and return outlets and other items affecting ceiling construction. Identify locations of types of suspension systems and types of panels or tile including access panels, where required.

C. Samples:
   1. Acoustical Board: Submit manufacturer’s standard color range.
   2. Suspension System: Submit manufacturer’s standard color range.

D. Product Data: Manufacturer’s specification, data, and installation instructions.
E. Certificates: Manufacturer's certified test reports for each specified NRC and STC requirement.

1.4 PRODUCT HANDLING

A. General: Refer to Section 01 31 00 – Coordination.

1.5 SITE CONDITIONS

A. Environmental Requirements: Maintain temperature approximating operational conditions, before, during and after installation; humidity not more than 70%.

1.6 MAINTENANCE

A. General: Refer to Section 01 77 00 – Closeout Procedures.

B. Extra Stock: Deliver one (1) percent or a minimum of one full container of each kind and type of acoustical material installed.

C. Guarantee: On form provided at end of Section 01 78 00 – CLOSEOUT SUBMITTALS, provide one (1) year written guarantee commencing from date of final acceptance by University’s Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers:

1. Specified products are manufactured by Armstrong World Industries, Inc., unless otherwise indicated.

2. USG Interiors, Inc., or equal

B. Acoustical Panels:

1. "Cortega Colortone": square edge, paint finish, in color selected by University's Representative from white to off-white; minimum NRC Range .50 - .60; ASTM E1264 flame spread rating of 25.

C. Ceiling Suspension System:

1. Exposed system of steel components; fire endurance rated where shown, complying with DSA IR 47-4, manufactured by the Chicago Metallic Corp.

2. USG Interiors, Inc., Armstrong World Industries, Inc., or equal

3. Standard Sections: Heavy-duty (16 lb/ft) main and cross runner members, assembly devices, wall moldings; other accessories as required; factory-painted in color selected by University's Representative.

4. Hanger Wires: 12 gage when spaced at 4 ft. or 10 gage when spaced at 5 ft., galvanized, soft-annealed mild steel wire of gage certified by load test data as capable of carrying five (5) times design load.
5. Compression Struts:
   a. Acceptable Manufacturers:
      1) "Donn Compression Post" manufactured by the USG Interiors, Inc.
      2) Armstrong World Industries, Inc. or equal.
   b. EMT shall be ANSI C80.3/UL 797 carbon steel with G90 galvanizing. EMT shall have minimum yield strength of \( fy = 30 \text{ ksi} \) and minimum ultimate strength of \( fu = 48 \text{ ksi} \).

D. Acoustical Sealant: As recommended by acoustical material manufacturer, for application shown.

E. Wall Molding:
   1. Molding shall have a horizontal flange of at least 2", unless otherwise required. The 2" wall angle is required at the attached and unattached perimeters.
   2. Armstrong 2" BERC Clip (BERC 2), or approved equal may be used in lieu of the 2" wall angle when 7/8" wall molding is used, and when the seismic strut layout is started within 5 feet of two adjacent walls.

PART 3 - EXECUTION

3.1 PREPARATION
   A. General: Refer to Division 1, Section 01 31 00 – Coordination.
   B. Examination: Examine conditions of work in place before beginning work; report defects.
   C. Surface Preparation: Comply with ASTM C636 Article 3, Interference of Ceiling Related Components; coordinate requirements with other trades. Verify that required work has been installed above ceiling and that perimeter wall work, where ceiling abuts, is completed and dry.

3.2 INSTALLATION
   A. General: Install in conformance with referenced standards, manufacturer's written directions, as shown, and as specified.
   B. Ceiling Suspension System:
      1. General: Conform to ASTM C636 and ASTM E580 and 4701(E) of CBC and suspension system manufacturer's instructions, non-cumulatively; main runners at 4'-0" on center, with support wires at 4'-0" on center, maximum; exposed members parallel with one another, in grid layout as shown.
      2. Splices and Intersections: Install with interlocking device that draws members tightly together and prevents torsional deflection.
      3. Compression Struts: Install as shown.
4. Perimeter Molding and Grid: Install intersections so fastenings are concealed, as shown.

5. Tolerances: Erect ceiling system level within \( \frac{1}{8} \)" in 12'-0" in any direction.

6. The ceiling grid must be attached to the molding at two adjacent walls.

7. Unattached ends of the grid system must have \( \frac{3}{4} ") clearance from the wall, and must rest upon and be free to slide on the molding.

8. Hanger wires must be plumb within 1 in 6 unless counter sloping wires are provided.

9. Hanging and seismic bracing wires must be 6" minimum clear from unbraced conduits, pipes, ducts, etc., and 1" minimum from braced conduits, pipes, ducts, etc.

C. Acoustical Panels: Install in ceiling suspension system, as shown.

D. Gypsum Board Inserts: Provided under Section 09 29 00 – Gypsum Board and painted under Section 09 91 00 – Painting. Install each panel on perimeter bead of acoustical sealant and attach hold-down clips.

E. Ceiling Fixtures, Terminals, and Devices

1. Ceiling panels shall not support any light fixtures, air terminals/grills, or other devices (referred to all by common term fixtures hereafter).

2. All fixtures shall be mounted in a manner that will not compromise ceiling performance.

3. All fixtures shall be attached to the suspended ceiling system by mechanical means, unless independently supported. The attachment device shall have the capacity of 100% of fixture weight acting in any direction. A minimum of two attachment devices are required for each fixture.

4. Surface mounted fixtures shall be attached to the main runner with positive clamping devices made of material with a minimum 14 gage. A no.12 gauge safety wire shall be attached between the clamping device and to the structure above. In no case shall the fixtures exceed the design capacity of the supporting members.

5. All light fixtures weighing less than or equal to 10 lb. Shall have one no. 12 gauge safety wire connected from fixture housing to structure above. It is not necessary for these safety wires to be taut.

6. All fixtures weighing greater than 10 lb but less than or equal to 56 lb. Shall have two no. 12 gauge safety wire connected from fixture housing to structure above. It is not necessary for these safety wires to be taut.

7. All fixtures weighing greater than 56 lb. Shall be supported directly from structure above by approved hangers.
8. Pendent-hung fixtures shall be supported directly from the structure above using no less than no. 9-gauge wire or an approved alternate support. The ceiling suspension system shall not provide any direct support.

9. All recessed or drop-in fixtures shall be supported directly from fixture housing to the structure above with a minimum of two no. 12 gauge wires located at diagonally opposite corners. Levelling or positioning of fixtures may be provided by ceiling grid. Fixture support wires may be slightly loose to allow the fixture to seat in the grid system. Fixtures shall not be supported from main runners or cross runners if the weight of the fixtures causes total dead load to exceed the deflection capability of the ceiling suspension system.

F. Penetrations:

1. Ceilings without a grid brace must have 2” oversize trim rings to allow 1” horizontal movement in all horizontal directions at sprinkler heads and other penetrations.

3.3 ADJUSTMENT

A. General: Adjust sags or twists which develop in ceiling systems; replace improperly installed or damaged suspension system components and acoustical panels, as directed by University's Representative.

B. Tolerances:

1. Maximum Variation from Flat and Level Surface: ⅛” in 10'-0”.


3.4 CLEANING

A. General: Upon completion, thoroughly clean exposed surfaces per manufacturer's instructions.

END OF SECTION 09 51 13
SECTION 09 65 13
RESILIENT FLOORING ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work of this Section shall include all materials and installation necessary to provide Resilient Wall Base and Accessories, including resilient wall base as shown and detailed on the Drawings and specified herein.

B. Related Sections include the following:

1. Section 09 65 19 – RESILIENT TILE FLOORING

1.2 SUBMITTALS

A. Product Data: For each type of product specified.

B. Samples for Verification: In manufacturer's standard sizes, but not less than 12" long, of each product color and pattern specified.

C. Product Certificates: Signed by manufacturers of resilient wall base and accessories certifying that each product furnished complies with requirements.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.

B. Source Limitations: Obtain each type and color of product specified from one source and one (1) dye lot per room with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E 648.

2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project location, including dye lot number and shipping and handling instructions.

B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50º and 90ºF.
C. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.5 PROJECT CONDITIONS

A. Maintain a temperature of not less than 70°F or more than 95°F in spaces to receive resilient products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After post-installation period, maintain a temperature of not less than 55°F or more than 95°F for a minimum of 48 hours.

B. Do not install products until they are at the same temperature as the space where they are to be installed.

C. For resilient products installed on traffic surfaces, close spaces to traffic during installation and for time period after installation recommended in writing by manufacturer.

D. Coordinate resilient product installation with other construction to minimize possibility of damage and soiling during remainder of construction period. Install resilient products after other finishing operations, including painting, have been completed.

1.6 EXTRA MATERIALS

A. Furnish extra materials installed, as described below packaged with protective covering for storage, and identified with labels describing contents.

1. Furnish not less than 10 linear feet for each 500 linear feet or fraction thereof, of each different type, color, pattern, and size of resilient product installed.

2. Deliver extra materials to University.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the Resilient Flooring Accessory Schedule at the end of Part 3.

B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Resilient Flooring Accessory Schedule at the end of Part 3.

2.2 RESILIENT WALL BASE

A. Rubber Wall Base: Products complying with FS SS-W-40, Type I and with requirements specified in the Resilient Flooring Accessory Schedule.

2.3 RESILIENT PRODUCTS

A. Rubber Wall Base: Products complying with FS SS-W-40, Type I and with requirements specified in the Resilient Tile Flooring Schedule.

2.4 INSTALLATION ACCESSORIES
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A. **Trowelable Leveling and Patching Compounds:** Latex-modified, portland-cement-based formulation provided or approved by resilient product manufacturer for applications indicated.

B. **Adhesives:** Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer’s requirements. Verify that substrates and conditions are free of defects and fully comply with manufacturer’s specified requirements for resilient product installation. Determine adhesion and dryness by performing flooring manufacturer’s recommended bond and Calcium Chloride Test for moisture. Concrete slabs moisture should not exceed 5 lbs. per 1,000 sq. ft. per 24 hours. Provide University's Representative with test results prior to installation for all concrete slabs.

**3.2 PREPARATION**

A. General: Comply with manufacturer’s written installation instructions for preparing substrates indicated to receive resilient products.

B. Use trowelable leveling and patching compounds, according to manufacturer’s written instructions, to fill cracks, holes, and depressions in substrates.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

D. Broom and vacuum clean substrates to be covered immediately before installing resilient products. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

**3.3 INSTALLATION**

A. General: Install resilient products according to manufacturer’s written installation instructions.

B. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

1. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

3. Do not stretch base during installation.
4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.

5. Form outside corners on job, from straight pieces of maximum lengths possible, without whitening at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.

6. Form inside corners on job, from straight pieces of maximum lengths possible, by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

C. Place resilient products so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.

D. Apply resilient products to stairs as indicated and according to manufacturer's written installation instructions.

3.4 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing resilient products:

1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.

2. Sweep or vacuum horizontal surfaces thoroughly.

3. Do not wash resilient products until after time period recommended by resilient product manufacturer.

4. Damp-mop or sponge resilient products to remove marks and soil.

B. Protect resilient products against mars, marks, indentations, and other 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 resilient product manufacturer.

1. Apply protective floor polish to vinyl resilient products installed on floors and stairs that are free from soil, visible adhesive, and surface blemishes, if recommended by manufacturer.

   a. Use commercially available product acceptable to resilient product manufacturer.

   b. Coordinate selection of floor polish with University's maintenance service.

2. Cover resilient products installed on floors and stairs with undyed, untreated building paper until inspection for Substantial Completion.
C. Clean resilient products not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.

3.5 RESILIENT FLOORING ACCESSORY SCHEDULE

A. Rubber Wall Base:

1. Products: Burke Cove Wall Base, as manufactured by Burke Flooring, or equal.
2. Color and Pattern: Match existing.
4. Minimum Thickness: ¼".
5. Height: 4" in Administrative areas and 6" in Hospital or clinic patient care areas.
7. Outside Corners: Formed on site.
8. Inside Corners: Formed on site.
10. Surface: Smooth.

END OF SECTION 09 65 13
SECTION 09 65 19
RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work under this Section shall include all materials and installation necessary to provide Resilient Tile Flooring as shown and detailed on the Drawings and specified herein and includes:

1. Vinyl Composition Floor Tile.

B. Related Sections include the following:

1. Section 09 65 13 – RESILIENT FLOORING ACCESSORIES for resilient wall base, reducer strips, and other accessories installed with resilient floor tiles.

1.2 SUBMITTALS

A. Product Data: For each type of product specified.

B. Samples for Verification: Sample tiles of each different color and pattern of resilient floor tile specified, showing the full range of variations expected in these characteristics.

1. For resilient accessories, manufacturer's standard-size samples.

C. Product Certificates: Signed by manufacturers of resilient products certifying that each product furnished complies with requirements.

D. Maintenance Data: For resilient floor tile to include in the maintenance manuals specified in Division 01.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.

B. Source Limitations: Obtain each type, color, and pattern of product specified from one source and dye lot per room with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

C. Fire Test Response Characteristics: Provide products with the following fire-test response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45 watts/cm² or greater when tested per ASTM 648.

2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

1.4 DELIVERY, STORAGE, AND HANDLING
A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, including dye lot number and shipping and handling instructions.

B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50º and 90ºF.

C. Store tiles on flat surfaces with cartons upright.

D. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.5 PROJECT CONDITIONS

A. Maintain a temperature of not less than 65ºF or more than 100ºF in spaces to receive products for at least 48 hours prior to installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After post-installation period, maintain a temperature of not less than 55ºF or more than 95ºF.

B. Condition all flooring materials and adhesives to room temperature prior to starting installation at the space where they are to be installed.

C. Cordon off spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.

D. Install tiles and accessories after other finishing operations, including painting, have been completed.

E. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive. See 3.1 "Examination" of this Specification.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents and Project location.

1. Furnish not less than one box for each 50 boxes or fraction thereof, of each type, color, pattern, class, wearing surface, and size of resilient tile flooring installed.

2. Furnish not less than 10 linear feet for each 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient accessory installed.

3. Deliver extra materials to University.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the Resilient Tile Flooring Schedule at the end of Part 3.

B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Resilient Tile Flooring Schedule at the end of Part 3.

C. Manufacturers: Mannington, Armstrong World Industries, Inc., Tarkett, Azrock, or equal.

2.2 RESILIENT TILE

A. Vinyl Composition Floor Tile: Products complying with ASTM F 1066.

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are free of defects and fully comply with manufacturer's specified requirements for resilient product installation. Determine adhesion and dryness by performing flooring manufacturer's recommended bond and Calcium Chloride Test for moisture. Concrete slabs moisture should not exceed 5 lbs. per 1,000 sq. ft. per 24 hours. Provide University's Representative with test results prior to installation for all concrete slabs.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and Calcium Chloride Test for moisture with a not to exceed 5 lbs. per 1,000 sq. ft. per 24 hours recommended by flooring manufacturer.

2. Subfloor finishes comply with requirements specified in Section 03 30 00 – Cast-in-Place Concrete for slabs receiving resilient flooring.

3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. General: Comply with resilient product manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

C. Use stair-tread-nose filler, according to resilient tread manufacturer's written instructions, to fill nosing substrates that do not conform to tread contours.

D. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

E. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 TILE INSTALLATION

A. General: Comply with tile manufacturer's written installation instructions.

B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter.
   1. Lay tiles square with room axis, unless otherwise indicated.

C. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.
   1. Lay all tiles with grain running in north/south direction. Do not quarter turn tiles.
   2. Lay tiles in pattern of colors and sizes indicated on Drawings.

D. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, doorframes, thresholds, and nosings.

E. Extend tiles into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent, nonstaining marking device.

G. Install tiles on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on covers. Tightly adhere edges to perimeter of floor around and to covers.

H. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to comply with tile manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Hand roll tiles according to tile manufacturer's written instructions.

3.4 RESILIENT ACCESSORY INSTALLATION

A. General: Install resilient accessories according to manufacturer's written installation instructions, refer to Section 09 65 13 – Resilient Flooring Accessories.

3.5 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing resilient products:

1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.

2. Sweep or vacuum floor thoroughly.

3. Do not wash floor until after time period recommended by flooring manufacturer.

4. Damp-mop floor to remove marks and soil.

B. Protect flooring against mars, marks, indentations, and other 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 flooring manufacturer.

1. Apply protective floor polish to floor surfaces that are free from soil, visible adhesive, and surface blemishes, if recommended in writing by manufacturer.

   a. Use commercially available product acceptable to flooring manufacturer.

   b. Coordinate selection of floor polish with University's maintenance service.

2. Cover products installed on floor surfaces with undyed, untreated building paper until inspection for Substantial Completion.

3. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

C. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.

1. Before cleaning, strip protective floor polish that was applied after completing installation only if required to restore polish finish and if recommended by flooring manufacturer.

2. After cleaning, reapply polish to floor surfaces to restore protective floor finish according to flooring manufacturer's written recommendations. Coordinate with University's maintenance program.
3.6 RESILIENT TILE FLOORING SCHEDULE

A. Vinyl Composition Tile VCT. Where this designation is indicated, provide vinyl composition floor tile complying with the following:

1. Products: Mannington Commercial, Inc. or equal.
2. Color and Pattern: Essentials, colors to match existing.
3. Class: Class 2 - through pattern
4. Thickness: ⅛” (3.2 mm)
5. Size: 12” x 12” tile

3.7 TECHNICAL DATA

A. Static Load Limit: 75 psi (5.27 kg/cm²) per test method ASTM F 970.

B. Fire Test Data:

1. ASTM E 648 Critical Radiant Flux-0.45 watts/ cm² or more, Class 1.
2. ASTM E 662 Smoke-450 or less.
3. Flame Spread 25 or less.
4. Smoke Developed 50 or less.

END OF SECTION 09 65 19
SECTION 09 91 00
PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Scope: Work under this Section shall include all materials and installation necessary to provide Painting including: exposed exterior items and surfaces, exposed interior items and surfaces, surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections as shown and detailed on the Drawings and specified herein.

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and ironwork, and primed metal surfaces of mechanical and electrical equipment.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:
   a. Finished mechanical and electrical equipment
   b. Light fixtures
   c. Distribution cabinets

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
   a. Foundation spaces
   b. Furred areas
   c. Ceiling plenums
   d. Utility tunnels
   e. Pipe spaces
   f. Duct shafts
   g. Elevator shafts

3. Finished metal surfaces include the following:
a. Anodized aluminum
b. Stainless steel
c. Chromium plate
d. Copper
e. Bronze and brass

4. Operating parts include moving parts of operating equipment and the following:
   a. Valve and damper operators
   b. Linkages
   c. Sensing devices
   d. Motor and fan shafts

5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include the following:
   1. Section 05 52 13 – Pipe and Tube Railings.
   2. Section 09 29 00 – Gypsum Board.
   3. Divisions 21 through 28: Painting of mechanical and electrical work.

1.2 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
   1. Flat refers to a lusterless or matte finish with a gloss range below 10 when measured at an 85º meter.
   2. Eggshell refers to low-sheen finish with a gloss range between 10 to 15 when measured at a 60º meter.
   3. Satin refers to low-sheen finish with a gloss range between 30 to 35 when measured at a 60º meter.
   4. Semi-gloss refers to medium-sheen finish with a gloss range between 50 to 55 when measured at a 60º meter.
   5. Full gloss refers to high-sheen finish with a gloss range more than 75 when measured at a 60º meter.

1.3 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.
1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer’s catalog number and general classification.

2. Manufacturer’s Information: Provide manufacturer’s technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.

3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

B. Samples for each color selection verification; of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.

2. Provide a list of materials and applications for each coat of each sample. Identify the manufacturer base paint information intended for each paint color. Label each sample with same identification number, manufacturer color name/number as listed in the finish schedule.

3. Submit Samples: 8-½” x 11” brush-outs for the Architect’s review for each color and texture specified.

C. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams “Custodian Project Color and Product Information” report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

D. Qualification Data: For firms and persons specified in the “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats unless specified otherwise.

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project. Duplicate finish of approved prepared samples.
1. The Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.
   a. Wall Surfaces: Provide samples on at least 100 sq. ft. of wall surface.
   b. Small Areas and Items: The Architect will designate an item or area as required.

2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.
   a. After finishes are accepted, the Architect will use the room or surface to evaluate coating systems of a similar nature.

3. Final approval of colors will be determined by University's Representative.

D. Contractor shall notify the University's Representative prior to the application of each coat of primer and paint to verify color and coating system.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
   1. Product name or title of material
   2. Product description (generic classification or binder type)
   3. Manufacturer's stock number and date of manufacture
   4. Contents by volume, for pigment and vehicle constituents
   5. Thinning instructions
   6. Application instructions
   7. Color name and number
   8. VOC content

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45°F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.6 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50°F and 90°F.
B. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85%; or at temperatures less than 5ºF above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in the paint schedules.

B. Products: Provide one of the products identified in the paint schedule for the base paint. Actual paint colors may be specified from other manufacturer. Add formulated colorants as required to base paint to achieve color specified.

C. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:

1. Kelly Moore Paints (KM)
2. Sherwin-Williams Co. (S-W)
3. Or equal.

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions under "Substitutions" in Section 01 60 00 – Product Requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.

1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as the Applicator’s acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting. Art and signage will be removed by the University. Notify the University’s representative well in advance of the intended removal date.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved. Notify University’s representative to reinstall items the University removed.

B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer’s written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.

2. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council’s (SSPC) recommendations.

   a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.

   b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

   c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

D. Materials Preparation: Mix and prepare paint materials according to manufacturer’s written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer’s written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the schedules.

2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

3. Provide finish coats that are compatible with primers used.

4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.

5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.

7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

8. Sand lightly between each succeeding enamel coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer’s written instructions, sand between applications.

2. Omit primer on metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

   1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.

   2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

   3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.

F. Mechanical items to be painted include, but are not limited to, the following:

   1. Piping, pipe hangers, and supports.


   3. Tanks.

   4. Ductwork.

   5. Insulation.

   6. Motors and mechanical equipment.

   7. Accessory items.

G. Electrical items to be painted include, but are not limited to, the following:

   1. Conduit and fittings.

   2. Switchgear.

   3. Panelboards.

H. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished.
and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

J. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

A. The University reserves the right to engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.

1. The University may direct the Contractor to stop painting if test results show material being used does not comply with specified requirements. The Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the 2 coatings are incompatible.

3.5 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide “Wet Paint” signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 INTERIOR PAINT SCHEDULE

A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

1. Low-Luster, Acrylic-Enamel Finish: 2 finish coats over a primer.
a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
   1) Kelly Moore, (KM) 971 PVA Primer
   2) Sherwin-Williams Co. (S-W) ProMar 200 Zero Primer, B28W2600

b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils.
   1) Kelly Moore (KM) 1510 Premium Eggshell Enamel
   3) Or equal.

   a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
      1) Kelly Moore (KM) 971 PVA Primer
      3) Or equal.
   
   b. First and Second Coats: Semi-gloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils.
      1) Kelly Moore (KM) 1650 Premium Semi-Gloss
      3) Or equal.

B. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Low-Luster, Acrylic-Enamel Finish: 2 finish coats over a primer.
   a. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.
      1) Rust Oleum CV740
2) Sherwin-Williams Co. (S-W) Pro Industrial ProCryl Metal Primer B66-310

3) Or equal.

b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils.

1) Kelly Moore (KM) 1510 Premium Eggshell Enamel


3) Or equal.

2. Semi-gloss, Acrylic-Enamel Finish: One finish coat over an enamel undercoater and a primer.

a. Primer: Quick-drying, rust-inhibitive, metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.

1) Rust Oleum CV740

2) Sherwin-Williams Co. (S-W) Pro Industrial ProCryl Metal Primer B66-310

3) Or equal.

b. Undercoat: Interior enamel undercoat or semi-gloss, acrylic-latex, interior enamel, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils.

1) Kelly Moore (KM) 1650 Premium Semi-Gloss Enamel


3) Or equal.

c. Finish Coat: Semi-gloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils.

1) Kelly Moore (KM) 1650 Premium Semi-Gloss Enamel


3) Or equal.
C. Cotton or Canvas Covering over Insulation: Provide the following finish system on cotton or canvas insulation covering:

1. Flat Acrylic Finish: 2 finish coats. Add fungicidal agent to render fabric mildewproof.
   a. First and Second Coats: Flat, latex-based, interior paint applied at spreading rate recommended by the manufacturer.
      1) Kelly Moore (KM) 550 Premium Flat
      2) Sherwin-Williams Co. (S-W) DTM Acrylic Primer Finish, B66W1.
      3) Or equal.

   END OF SECTION 09 91 00
DIVISION 10
SPECIALTIES
SECTION 10 26 00
IMPACT RESISTANT WALL PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work under this Section shall include all materials and installation necessary to provide Impact-Resistant Wall Protection including Wall guards as shown and detailed on the Drawings and specified herein.

B. Related Sections include the following:
   1. Section 09 22 16 – METAL STUD SYSTEM for blocking/backing for items specified in this Section.
   2. Section 09 29 00 – GYPSUM BOARD.

1.2 SUBMITTALS

A. Product Data: Include physical characteristics, such as durability, resistance to fading, and flame resistance, for each impact-resistant wall protection system component indicated.

B. Shop Drawings: Show locations, extent, and installation details of each impact-resistant wall protection system component. Show methods of attachment to adjoining construction.

C. Samples for Initial Selection: Manufacturer's color charts consisting of sections of vinyl plastic material showing the full range of colors and textures available for each impact-resistant wall protection system component indicated.

D. Samples for Verification: For the following products, showing the full range of color and texture variations expected in each impact-resistant wall protection system component. Prepare Samples from the same material to be used for the Work.
   1. Wall Guards: 12” long Samples of each type of impact-resistant wall protection system component required. Include examples of joinery, corners, and field splices.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed installation of impact-resistant wall protection system components similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: A firm experienced in manufacturing impact-resistant wall protection system components similar to those required for this Project and with a record of successful in-service performance.

C. Source Limitations: Obtain each color, grade, finish, and type of impact-resistant wall protection system component from a single source with resources to provide components of consistent quality in appearance and physical properties.
D. Product Options: Information on Drawings and in Specifications establishes requirements for systems aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sight-lines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, or in-service performance.

E. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection system and are based on the specific system indicated.

F. Fire-Test-Response Characteristics: Provide impact-resistant wall protection system components with the following surface-burning characteristics, as determined by testing materials identical to those required in this Section per ASTM E 84 by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify impact-resistant wall protection system components with appropriate markings of applicable testing and inspecting agency.

1. Flame Spread: 25 or less.
2. Smoke Developed: 450 or less.

G. Impact Strength: Provide impact-resistant wall protection system components with a minimum impact resistance of 25.4 ft.-lb./in. of width when tested according to ASTM D 256, Test Method A.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not install wall surface-protection system components until the space is enclosed and weatherproof and ambient temperature within the building is maintained at not less than 70°F for not less than 72 hours before beginning installation. Do not install rigid plastic wall surface-protection systems until that temperature has been attained and is stabilized.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements:

1. Acrovyn, Pawling, or equal.

2.2 MATERIALS

A. Extruded Rigid Plastic: Textured, chemical and stain-resistant, high-impact-resistant, PVC or acrylic-modified vinyl plastic; thickness as indicated; with a minimum impact resistance of 25.4 ft.-lb./in. of width when tested according to ASTM D 256, Test Method A.

1. Color and Texture: As selected by University's Representative from manufacturer's full range for these characteristics.

B. Aluminum Extrusions: Provide alloy and temper recommended by the manufacturer for the type of use and finish indicated, but with not less than the strength and durability properties specified in ASTM B 221 for alloy 6063-T5.
C. Fasteners: Provide aluminum, nonmagnetic stainless-steel, or other non-corrosive metal screws, bolts, and other fasteners compatible with aluminum components, hardware, anchors, and other items being fastened. Use theft-proof fasteners where exposed to view.

D. Adhesive: Non-flammable type recommended by the manufacturer for use with material on the substrate indicated.

2.3 WALL GUARDS

A. Crash-Rail-Type Wall Guards: Nominal 8” high by 1” deep; heavy-duty assembly consisting of a snap-on-type rigid plastic cover installed over a continuous aluminum retainer mounted at height indicated.

1. Cover: Extruded, rigid plastic, minimum 0.110” thick, in profile indicated.

2. Retainer: Continuous, one-piece, extruded-aluminum retainer; minimum 0.0625” thick; with continuous rubber or vinyl bumper cushion centered in the extrusion.

   a. Mounting Type: Surface mounted flush on wall or as indicated on drawings.

   b. Mounting Type: Extended mounting on high-impact mounting brackets.

3. Accessories: Provide prefabricated, injection-molded end caps and inside and outside corners with concealed splices, cushions, mounting hardware, and other accessories as required.

   a. End caps and inside and outside corners shall match plastic cover color and shall be field adjustable for close alignment with snap-on plastic covers.

2.4 FABRICATION

A. General: Fabricate impact-resistant wall and door protection systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including thickness of components.

B. Pre-assemble components in the shop to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

D. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors for interconnecting members to other construction.

E. Provide inserts and other anchoring devices for connecting components to concrete or masonry. Fabricate anchoring devices to withstand imposed loads. Coordinate anchoring devices with the supporting structure.

2.5 FINISHES, GENERAL
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 covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 606.1 or AAMA 608.1.

1. Color: As selected by University's Representative from the full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions in which impact-resistant wall protection system components and impact-resistant wall covering materials will be installed.

1. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Install impact-resistant wall protection system components level, plumb, and true to line without distortions.

1. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Install aluminum retainers, mounting brackets, and other accessories according to the manufacturer's written instructions.

1. Where splices occur in horizontal runs of more than 20’ (6.1 m), splice aluminum retainers and plastic covers at different locations along the run.
3.4 CLEANING

A. General: Immediately on completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent. Clean metal components according to the manufacturer's written instructions.

B. Remove excess adhesive using methods and materials recommended by the manufacturer.

END OF SECTION 10 26 00
SECTION 10 28 00
TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work under this Section shall include all materials and installation necessary to provide Toilet and Bath accessories as shown and detailed on the Drawings and specified herein.

B. Related Sections include the following:

1. Section 09 30 00 – CERAMIC TILE.

1.2 SUBMITTALS

A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Samples: 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. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

D. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.

E. Maintenance Data: For accessories to include in maintenance manuals specified in Division 01. Provide lists of replacement parts and service recommendations.

1.3 QUALITY ASSURANCE

A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by University’s Representative.

1.4 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Coordinate delivery inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering accessories that may be incorporated into the Work include, but are not limited to, the following:

1. Bobrick.
2. American Specialties, Inc.
4. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fixtures, accessories and items in accordance with manufacturers' instructions.

B. Install all items plumb and level.

C. Secure all items rigidly in place. Anchor to structure with anchors appropriate for use with type of adjacent construction. Fasteners shall securely fasten items to wall construction involved. Fasteners shall provide stiffness and rigidity to keep items square, in accurate position without twisting, buckling or warping. Fasteners to framing substrate shall be the following minimums; greater as required by the toilet accessory manufacturer or as conditions warrant:

1. Metal Framing: #10 corrosion resistant self-tapping sheet metal screws by length as required to penetrate framing member 1/4 inch minimum.

END OF SECTION 10 28 00
DIVISIONS 11 – 20
NOT USED
DIVISION 21
FIRE SUPPRESSION
SECTION 21 13 13
FIRE PROTECTION

PART I - GENERAL

1.01 RELATED SECTIONS

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

1.02 WORK INCLUDED

A. Furnish all labor, materials, tools, and equipment to complete the automatic fire sprinkler system as hereinafter described, ready for service to the entire satisfaction of the University's Representative and University Fire Department. Provide hydraulically calculated systems for light and ordinary hazard occupancy as noted in NFPA 13, 2013 edition or latest adopted code by authority having jurisdiction. Provide calculations based on 10% minimum safety factor.

B. Determine the static and residual pressure for the site as required for accurate determination of system requirements. Base system calculations on the lowest expected static and residual pressure for the area.

C. It is the intent of these Specifications and Drawings to provide for a complete and operating automatic fire protection sprinkler system in full compliance with the standards of the National Fire Protection Association as set forth in NFPA Pamphlet No. 13, 2013 edition or latest code adopted by authority having jurisdiction. The work must also be in accordance with all local or state requirements which apply.

1.03 JOB CONDITIONS

A. Coordinate Work of this Section with that of other Sections to ensure that Work shall be carried out in an orderly fashion.

B. Coordinate all equipment locations, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

1.04 QUALITY ASSURANCE

A. Firms regularly engaged in manufacture of fire protection products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Requirements of Regulatory Agencies:

1. NFPA Compliance: Install fire protection systems in accordance with the following standards:

2. UL Compliance: Provide fire protection products in accordance with UL standards; provide UL label on each product.

3. All piping used on this project shall be both UL listed and FM approved.
4. Fire Department/Marshal Compliance: Install fire protection systems in accordance with local regulations of University Fire Department and State Fire Marshal.

5. Screw Thread Connections: Comply with local fire department/marshal regulations for sizes, threading, and arrangement of connections for fire department equipment to systems.


D. Installation of the sprinkler system shall not be started until complete plans and specifications (including water supply information and type of existing sprinkler system) have been reviewed and approved by the University Fire Department.

E. Reference Standards:

1. FS: Federal Standards
   a. WW-P-406D: Pipe, Steel (Seamless and Welded) (For Ordinary Use).
   b. WW-P-521G: Pipe Fittings, Flanged Fittings, Flanges, Ferrous and Steel (Screwed and Butt-Welded).
   c. WW-P-501E: Pipe Fittings, Cast Iron, Screwed 125 and 250 Pound.

1.05 SUBMITTALS

A. Reflected Ceiling Plans: Provide Drawings showing location of all sprinkler heads throughout the building or project area and their relationship to all other materials forming part of the ceiling system. No fire sprinkler piping shall be shown on these Drawings. Submit drawings to University's Representative prior to any other work.

1. Submit six sets of sprinkler location Drawings in all areas. Prepare these Drawings prior to the preparation of Engineered Drawings required herein before. Superimpose these Drawings upon reflected ceiling plans and show ceiling module, light fixtures, air inlets and outlets, and tile pattern where applicable.

2. Adjustments by the University's Representative in these head locations are to be anticipated by the Contractor and shall be allowed for in bidding. No extra compensation will be allowed for spacing of sprinklers closer than the maximum area of coverage allowed by NFPA 13 where it is necessary to suit the ceiling module and lighting layout.

B. Drawings: Prepare Shop Drawings and product data of fire protection systems indicating pipe sizes, pipe locations, fittings, shutoffs, equipment, etc. Submit to University's Representative for review. Submit six reviewed sets to agency having jurisdiction, with Architect / Engineer stamp shown on each drawing before proceeding with installation. Include CSFM listing number on products submitted for review.

C. Calculations: Prepare hydraulic calculation of fire protection systems. Submit to University's Representative for review. Submit six reviewed sets to authority having jurisdiction, with Architect's/Engineer's stamp shown on each drawing and/or signature of agency having jurisdiction, before proceeding with installation.

D. Product Data: Submit manufacturer's original technical product data (not photocopies) for fire protection materials and products with CSFM listing numbers as part of submittal to University's Representative. Clearly identify components intended for use. Submit six
reviewed sets with Architect's / Engineer's stamp and signature to authority having jurisdiction.

E. Record Drawings: Using the fire sprinkler system as-built drawings and your own records of any other pertinent changes during construction, apply the information to produce a facility set of Record Drawings on CAD for the University document archives. Include as part of these drawings products and site information including supply pressures. The University will receive CAD drawings via appropriate electronic transmission medium, and one set of full-size reproductions plotted on 4-mil thick wash-off polyester drafting film with matte finish. These drawings shall be clearly labeled “Fire Sprinkler System Record Drawings”. Computer CAD files shall be fully compatible with the University CAD system. The University will provide direction for CAD standards to be used for document deliverables. (Also see Division 1, General Requirements, Sections 01770 Closeout Procedures and 01780 Closeout Submittals).

F. Maintenance Data: Submit maintenance data and parts lists for fire protection materials and products. Include this data, product data, drawings, calculations, certificate of installation, and Record Drawings in maintenance manual in accordance with requirements of Division 1.

1. Certificate of Installation: Submit certificate upon completion of fire protection piping work which indicates that work has been tested in accordance with NFPA 13 and NFPA 14 and that system is operational, complete, and has no defects.

G. Provide a list of control valves, drains and inspectors test valves. The list shall be in a matrix format and provide the room number where the valve or drain is located and size of valve or drain.

PART II - PRODUCTS

2.01 GENERAL

A. Provide new piping materials and factory-fabricated piping products of sizes, types, pressure rating, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Contractor to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in fire protection systems. Where more than one type of material or product is indicated, selection is Contractor's option.

B. Equipment to be furnished under this specification shall be standard product of manufacturer. Where two or more units of same class of equipment are required, these units shall be products of a single manufacturer. However, component parts of system need not be products of same manufacturer.

2.02 BASIC IDENTIFICATION

A. Provide identification complying with Division 22, Plumbing Work in accordance with the following listing:

2. Fire Protection Signs: Provide the following signs:
   a. At each sprinkler valve, including roof manifold, sign indicating what portion of system valve controls.
b. At each outside alarm device, sign indicating what authority to call if device is activated.

2.03 BASIC PIPES AND PIPE FITTINGS

A. General: Provide pipes and pipe fittings complying with Division 22 - Plumbing Work in accordance with the following listing:

B. Pipe:

1. For installation below ground - ductile iron, Federal Specification WW-P-421d, Type I, II, III, Class 200.
2. At contractor's option, piping more than 2' from building may be Polyvinyl chloride (PVC) water pipe; Class 200, DR-14; cast-iron or ductile-iron fittings, ring-tile joints. Pipe shall be listed as AWWA C900.
3. For installation above ground, steel pipe, Federal Specifications WW-P-406, Type I, Class A, black.
4. Schedule 10 piping may be used subject to review by University Fire Department.
5. Threadable thin wall pipe is prohibited.

C. For installation above ground - Schedule 40 black steel pipe - in accordance with ASTM A 135 and A 53.

1. At contractor's option, pipe may be steel Schedule 10 black; in accordance with ASTM A 135.

D. Pipe Fittings:

1. For installation below ground - For use with cast iron pipe, American Water Works Association Standard Specification C100, Class D, 200 pounds; or listed as approved by Underwriters' Laboratories, Inc., list of Inspected Fire Protection Equipment and Materials or approved by any other appropriate, nationally recognized testing laboratory for use in sprinkler system.
2. For installation above ground, Federal Specification WW-P-501, Type I, Class A piping. Exterior piping must be protected against freezing.

2.04 BASIC PIPING SPECIALTIES

A. Provide piping specialties complying with Division 22, Plumbing Work in accordance with the following listing:

1. Pipe escutcheons
2. Dielectric unions
3. Pipe sleeves
4. Sleeve seals

2.05 BASIC SUPPORTS AND ANCHORS

A. Provide supports and anchors complying with Division 22, Plumbing Work in compliance with NFPA Pamphlet No. 13.
B. Provide calculations and details for support and bracing members and connections not covered by NFPA 13, or where applicable, refer to the SMACNA "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems".

2.06 BASIC VALVES

A. Provide valves complying with Division 22, Plumbing Work in accordance with the following listing:

1. Interior Valves:
   a. Sectional: Gate valves or butterfly valves; UL listed.
   b. Check: Swing check valves; UL listed.

2. All backflow assemblies on new installations, retrofits, relocated assemblies, or repaired assemblies shall be tested when they are put back into service.

2.07 FIRE PROTECTION SPECIALTIES

A. Provide fire protection specialties, UL listed, in accordance with the following listing. Provide sizes and types which match piping and equipment connections.

1. Install drains on main risers and auxiliary drains at all low points in the system.
2. At least one inspector's test drain shall be installed for each sprinkler system.
3. Drains and inspector's tests shall be of number and at locations directed and approved by the University Fire Department.
   a. Provide drain line to floor sink or to outside, as required, to suit Project conditions. Floor sink must be able to accommodate water from drain line with valve in fully opened position without spillage onto floor.

4. Five or fewer trapped heads will not require a drain valve but may be drained through a plugged fitting.
5. Drain valve shall be of the angle type. Install in accordance with the requirements of NFPA Pamphlet No. 13.
6. Pipe drain valves to the outside of the building. Discharge shall be visible from sight drain fitting or open-end drain pipe. Provide flushing connections at ends of all cross mains.

2.08 AUTOMATIC SPRINKLERS

A. Provide automatic sprinklers in accordance with the following listing. Provide fusible links for 165°F. unless otherwise indicated or directed by University Fire Department.

B. Type: Spray-pattern type, automatic closed-type heads of ordinary degree temperature rating, except that sprinklers to be installed in vicinity of heating equipment or in skylights shall be of temperature ratings required for such locations by University fire Department.

C. Type of Sprinklers:

1. Exposed Locations: Provide upright type heads at all areas with no finished ceilings.
   a. Where heads are located at height of less than 8’ above finished floor, provide wire guards to protect heads from damage.
2. Concealed Locations: Provide upright-type heads or pendent-type heads.
4. Finished Ceilings: Locate at all ceilings with lay-in acoustical tile ceiling and at plaster or gypsum board type ceilings.
   a. Provide satin chrome finish and white ceiling plates.
5. All sprinkler heads provided shall be appropriate for the building conditions.
6. Sprinkler Cabinet and Wrench: Furnish steel, baked red enameled, sprinkler box with capacity to store sprinklers and wrench sized to sprinklers. Spare sprinklers and wrenches called for under "Extra Stock." Location to be determined by University Fire Department.


PART III - EXECUTION

3.01 LOCATION OF EQUIPMENT AND VALVES
   A. Provide fire department connection to building where indicated on Drawings.
   B. Provide zone valves and sprinkler systems as shown on contract drawings and specified by the University Fire Department. Provide zone valves less than 7 feet above finished floor unless approved by UCDHS Fire Department.

3.02 INSPECTION
   A. Examine areas and conditions under which fire protection materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Contractor.

3.03 INSTALLATION OF BASIC IDENTIFICATION
   A. Install mechanical identification in accordance with Division 22 - Plumbing Work.
   B. Install fire protection signs on piping in accordance with NFPA 13 and NFPA 14 requirements.

3.04 INSTALLATION OF PIPES AND PIPE FITTINGS
   A. Install pipes and pipe fittings in accordance with Division 22 - Plumbing Work.
   B. Comply with requirements of NFPA 13 and NFPA 14 for installation of fire protection piping materials. Install piping products where indicated, in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that piping systems comply with requirements and serve intended purposes.
   C. Coordination: Coordinate all piping, heads, and sprinkler work to Architectural, Structural, Mechanical, and Electrical Work. Conceal piping, except where so indicated otherwise or where absolutely necessary. Place exposed piping where required by the University's Representative. Provide any offsets or additional piping required to coordinate this system with all other Work.
D. Any differences or disputes concerning coordination, interference, or extent of work shall be decided by University and this decision shall be final.

E. Supply System: Provide supply connections as required to service the sprinkler system.

F. Installation shall conform to the applicable requirements of NFPA pamphlet Number 13.
   1. Details of bracing must comply with OSHPD preapproval of manufacturer’s certification (OPM).

G. Make connections to water stub covered in civil work with fittings suitable for the particular conditions encountered.

H. Supply System: Provide supply connections as required to service the sprinkler system.
   1. Install a blank flange temporarily on flange to prevent entrance of foreign matter into supply line.

I. Make joints as specified herein and in a manner approved by University Fire Department. Leave joints exposed until final inspection and tests have been made.

J. Brace or clamp bends in accordance with the requirements of NFPA Pamphlet 13. The clamp rods at the flange and spigot piece shall be long enough to pass through the flange.

K. Before connection of sprinkler system to underground supply, flush supply connections out thoroughly in accordance with NFPA 13.

L. Excavation and backfill is a part of this work and shall be as specified in Division 22 - Plumbing Work. Depth of cover shall be in accordance with NFPA 24.

M. Piping and Fittings Above Ground:
   1. Install pipe, fittings, and hangers in accordance with requirements of NFPA Pamphlet No. 13.
   2. Cutting structural members for passage of sprinkler piping or for pipe hanger fastening will not be permitted except on review of the Structural Engineer as well as University's Representative for each specific case.
   3. Holes through walls, floors, and ceilings shall be large enough to accommodate pipe expansion. Provide approved fire penetration protection at each hole to maintain the fire rating of floor or wall. Foundation penetration shall have a 2" clearance all the way space around pipe and sealed watertight.
   4. Provide long runs of pipe with suitable means to permit free movement due to expansion and contraction.
   5. Make reduction in pipe sizes with one-piece concentric tapered reducing fittings. Bushings will not be acceptable.
   6. Couplings shall not be used except where the length of pipe between fittings exceeds 20’.
   7. Use flanged fittings in control valves and drain assembly and at the base of risers.
   8. Use malleable iron unions of the ground joint type in looped sprinkler systems where pipe is 2” in diameter or smaller. Where loops larger than 2” are used, companion flanges shall be installed.
9. Install sectional valves in inlet piping, at bottom of each riser, and in all loops as required.
10. Mount supervisory switches on each sectional valve.
11. Install pressure gages at top of each standpipe.
12. Install valved hose connections ¾” size on sprinkler at ends of branch lines and cross mains.
13. Install inspector's test connection at most remote point from riser or as approved by the University Fire Department.

3.05 INSTALLATION OF SPRINKLERS IN FINISHED CEILINGS

A. Where heads are located in grid or tile ceilings with regular pattern, heads shall be in center of tile or grid measured in both directions.

3.06 CARE AND CLEANING

A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to University's Representative and University Fire Department. At completion, carefully clean and adjust equipment and trim that are installed as part of this work. Leave systems and equipment in satisfactory operating condition.

3.07 FIELD QUALITY CONTROL

A. Sprinkler Piping Flushing: Prior to connecting sprinkler risers for flushing, flush water feed mains, lead-in connections, and control portions of sprinkler piping. After fire sprinkler piping installation has been completed and before piping is placed in service, flush entire sprinkler system as required to remove foreign substances under pressure as specified in NFPA 13. Continue flushing until water is clear, and check to ensure that debris has not clogged sprinklers. Test the fire sprinkler system floor by floor prior to covering the pipe. Once each floor is tested the entire system will then be tested.

B. Hydrostatic Testing: After flushing entire system, test fire sprinkler piping hydrostatically for period of 2 hours at not less than 200 psi or at 50 psi greater than system pressure where pressure is anticipated to be in excess of 150 psi in the presence of the California State Fire Marshal and the University Fire Department Representative. The system will not have visible leaks. Any visible leaks shall be repaired and system will be retested. Measure hydrostatic pressure at low point of each system or zone being tested.

3.08 ADJUSTING AND CLEANING

A. Cleaning and Inspecting: Clean and inspect fire protection systems in accordance with requirements of Division 22 - Plumbing Work.

3.09 EXTRA STOCK

A. Heads: For each style and temperature range required, furnish additional sprinkler heads, amounting to one unit for every 100 installed units but not less than 10 heads, in proportion to the total number of each style of head.

B. Wrenches: Furnish two sprinkler wrenches for each type and size of sprinkler connection.

C. Obtain receipt from University that extra stock has been received.
3.10 OPERATION TEST

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

B. Contractor shall provide for University Fire Department final inspection of the sprinkler system with the following:

1. Approved fire sprinkler drawings, including supply from site and site supply pressures.
2. Specifications of installed products indicating all applicable UL numbers.
3. Specifications of all fire stopping materials and assembly details in addition to California State Fire Marshal approved assembly numbers as appropriate.
4. Contractor's material and testing certificate with all information complete and accurate.

3.11 CLEANING UP

A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION 21 13 13
SECTION 22 05 00
PLUMBING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED SECTIONS

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. The intent of Division 21, 22 and 23 Specifications and Drawings is to provide complete and workable mechanical systems as shown, specified and required by applicable codes. Include all work specified in Division 21, 22 and 23 and shown on the Drawings, including appurtenances, connections, demolition, appliances, and incidental accessories to make work complete and ready for operation.

B. The General and Supplemental Conditions and Division 1 apply to this Division.

C. The Drawings that accompany the Division 21, 22 and 23 Specifications are diagrammatic. They do not show every offset, pipe/duct fitting, or elbow that may be required to install work in the space provided and avoid conflicts. Locations of all items not definitely fixed by dimensions are approximate only. Coordinate Division 21, 22 and 23 work as required by Division 1.

D. Include minor details not usually shown or specified, but necessary for proper installation and operation of a system or piece of equipment in work and in bid price, the same as if specified or shown.

1.3 ENFORCEABLE CODES

A. The code publications listed below form a part of this specification.

1. 2013 California Administrative Code (CAC), Part 1, Title 24, California Code of Regulations (CCR)
2. 2013 California Building Code (CBC), Part 2, Title 24, CCR (Based on the 2006 IBC)
3. 2013 California Electrical Code (CEC), Part 3, Title 24, CCR, (Based on the 2005 NEC)
4. 2013 California Mechanical Code (CMC), Part 4, Title 24, CCR, (Based on the 2006 UMC)
5. 2013 California Plumbing Code (CPC), Part 5, Title 24, CCR, (Based on the 2006 UPC)
6. 2013 California Fire Code (CFC), Part 9, Title 24, CCR, (Based on the 2006 IFC)

1.4 REFERENCES

A. Publications and standards listed below form a part of this specification to the extent referenced. The publications and standards are referred to in the text by basic designation only.

1. Applicable municipal, county, and state mechanical, electrical, gas, plumbing, health and sanitary codes, laws and ordinances.
2. Standards and requirements of local utility companies.
3. National Electrical Manufacturer's Association Standards.
10. American Society of Mechanical Engineers Boiler and Pressure Vessel Codes.
14. Commercial and Industrial Insulation Standards.
17. Sheet Metal and Air conditioning Contractor’s National Association Standards.

1.5 SUBMITTALS

A. Comply with requirements of Division 1.
B. Submit 6 copies of shop drawings, product data, samples, schedules and reports as required by individual Division 21, 22, and 23 Sections.

1.6 QUALITY ASSURANCE

A. Provide Work and materials in accordance with the latest rules and regulations of the California State Fire Marshal and the California State Department of Public Health, Titles 17 and 24; the California Plumbing Code and California Mechanical Code, IAPMO; the NFPA Pamphlet 13, 14, 24, 291; and other applicable laws or regulations.
B. Where the standards of the drawings and specifications for materials and/or workmanship are higher than the requirements of the regulations cited above, the drawings and specifications shall take precedence; otherwise the documents shall govern.
C. Provide materials and apparatus that bear the UL label where such label is applicable.

1.7 DELIVERY, STORAGE AND HANDLING

A. Protect materials from corrosion and breakage. Store materials above grade. Provide appropriate covering.

1.8 SITE VISITATION

A. Visit the site prior to bidding and become familiar with existing conditions and other factors which may affect the execution of work. Include all related costs in the initial bid proposal.

1.9 WARRANTY

A. Comply with requirements of Division 1.
B. Provide manufacturer’s written warranties covering defects in material and workmanship of products and equipment utilized for the project.
C. Each complete system shall be warranted for a period of one year from date of Substantial Completion.
D. Each system shall be free of defects of materials and workmanship, and shall perform satisfactorily under all conditions of load or service.

E. The warranties shall provide that all additional controls, protective devices, or equipment be provided as necessary for operation of the system or equipment.

F. Replace or repair faulty materials or workmanship at no additional cost to University.

1.10 OPERATING INSTRUCTIONS MANUALS

A. Provide 2 copies of complete Manual, bound in booklet form. Each Manual shall contain the following information:

1. List of all equipment with manufacturer’s name, model number, and local representative, service facilities and normal channel of supply for each item.
2. Manufacturer's literature describing each item of equipment with detailed parts list.
3. Individual guarantees.
4. Certificates of Inspection.
5. Record Blueprints and related Shop Drawings.
6. Air Systems Balance Reports.

1.11 RECORD DRAWINGS

A. Maintain at site an up to date set of black or blue line prints of Engineering Drawings which clearly indicate (by shading, coloring or some other acceptable method) the daily extent of Work installed.

B. Indicate on Drawings changes in elevation, location or size of material deviating from original design.

C. Clearly indicate any dimension changes in elevation, location, size or material, and offsets valves.

D. Locate all underground, concealed or buried piping by 2 or more dimensions per turn of pipe between each direction change.

E. Show all elevations (invert or centerline) with the point of elevation change clearly located.

F. Number and letter valves to correspond with number and letters of valve charts.

G. At conclusion of contract work, provide the University with a complete set of reproducible drawings with all changes clearly marked to reflect as-built conditions. These drawings shall be labeled "As-Built."

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers’ names and model numbers used for materials, processes or equipment in Division 21, 22 and 23 provide the basis for design and minimum standards of quality, utility and appearance.
2.2 SUBSTITUTIONS

A. For substitutions see Division 1.

PART 3 - EXECUTION

3.1 CONNECTIONS TO EXISTING WORK

A. General

1. Install new work and connect to existing work with minimum interference to existing facilities. Schedule any system interruption with University’s facility personnel.
2. Provide temporary shutdowns of existing services only with written consent of University. Perform this work at no additional charges and at times that do not interfere with normal operation of existing facilities.
3. Maintain continuous operation of existing facilities as required with necessary temporary connections between new and existing work.
4. Do not interrupt alarm and emergency systems without consent of University.
5. Where connections or disruptions are made to existing systems, reactivate, refill and recharge all components and restore systems to the same operating conditions prior to the time of disruption.

3.2 DEMOLITION

A. Comply with the requirements of Section 02 41 00 SELECTIVE STRUCTURAL DEMOLITION.

B. Remove ductwork, piping controls, fixtures, and equipment not to remain in service as shown on Drawings or as required. This includes the removal of associated appurtenances and supports.

C. Patch, cap, or repair existing work affected by this demolition in concealed spaces with six (6) inches of a live main or branch.

D. Deliver removed material to be retained by the University for storage on-site as directed by the University’s Representative. Dispose of all other removed material off site.

E. Where hazardous and carcinogenic materials are encountered, stop the work immediately and notify University’s Representative.

3.3 INSTALLATION

A. General Installation Method:

1. Examine site related work and surfaces before starting work of any Section.
   a. Report to University, in writing, conditions which will prevent proper execution of this work.
   b. Beginning work of any Section without reporting unsuitable conditions to University constitutes acceptance of conditions by Contractor.
   c. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to University.
B. Provide a complete properly operating system for each item of equipment called for under this work. Install in accordance with equipment manufacturer's written instructions, published standards, the best industry practices and the Contract Documents.

C. Make installation in a neat, finished and safe manner.

D. Coordinate with shop drawings for work done by other trades.

E. Verify all dimensions by field measurements.

F. Arrange for chases and openings in other building components during progress of construction, to allow for installation of ductwork and piping.

G. Coordinate the installation of required supporting devices and sleeves.

H. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

I. Install systems, materials, and equipment to comply with approved submittal data. Comply with arrangements indicated by the Drawings, recognizing that portions of the work are shown only in diagrammatic form.

J. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

3.4 PIPE EXPANSION, CONTRACTION, VIBRATION

A. Install pipe connections to allow for movement of piping during expansion, contraction or vibration. Provide expansion loops, flex connections and expansion joints with proper anchors and guides as required or where shown on Drawings. Anchors and guides shall be subject to review.

B. Motor driven equipment shall operate quietly and shall be free of vibration.

C. Construct and brace metal partitions, ducts, sheet metal housings, and similar items, so that there will be no vibration or rattling when the system is in operation.

D. Design and construct connections to the equipment so that noise and vibration will not reach the conditioned areas through ducts, conduits, piping and sheet metal of the building construction.

3.5 SCAFFOLDING, RIGGING AND HOISTING

A. For requirements of this work see Division 1.

3.6 MANUFACTURER'S IDENTIFICATION

A. Manufacturer's nameplate, name or trademark shall be permanently affixed to all equipment and material furnished under this Specification. The nameplates of Subcontractor or Distributor are not acceptable.
3.7 CUTTING AND PATCHING

A. Comply with requirements of Division 1.

B. Cut completed construction Work only where sleeves, openings, chases, and similar items were inadvertently omitted and only with specific permission of the University. In no case shall reinforcing steel be cut without specific written permission of the University.

C. Provide sleeves, caps, plates, escutcheons, flashing, and similar items required to fill or close the openings.

D. Provide final grouting, concrete, asphalt, masonry, painting and other materials as required to complete patch work.

E. Where cutting and patching occurs in streets, sidewalks, alleys and the like, cooperate fully with University and municipal or other government bodies to match existing materials.

3.8 OPERATION BY UNIVERSITY

A. University may require operation of parts or all of respective installations prior to final acceptance. Cost of utilities for such operation shall be paid by University.

B. Operation of installation shall not be construed as acceptance of Work.

3.9 TESTS AND ADJUSTMENTS

A. Labor, materials, instruments and power required for testing provided under respective Sections for Work under that Section.

B. Tests shall be performed as specified or as required by regulating authority having jurisdiction. Submit to University certification that tests have been performed in accordance with Contract Documents. Also refer to Section 01 45 23 for notification requirements and Section 01 86 00 for testing procedures.

C. Pressure test piping before connection to equipment. No piping, equipment or accessories shall be subjected to pressures exceeding their indicated rating.

D. Repair or replace defective Work and repeat tests until particular systems, and component parts thereof, receive approval of University and regulating authority.
   1. Any damages resulting from tests shall be repaired and damaged materials replaced at no cost to University.

E. Equipment and systems which normally operate during certain seasons of year shall be tested during the appropriate season.
   1. Perform tests on individual equipment, systems and their controls.
   2. Whenever the equipment or system under test is inter-related with, and depends upon the operation of other equipment or systems and their controls for proper operation, functioning, and performance, the latter shall be operating simultaneously with equipment or system being tested.

F. No piping shall be closed up, furred in, or covered before testing. Notify regulating authority and University 3 days before tests are to be conducted.
G. Test all systems as specified under various applicable Sections. Duration of tests shall be determined by the authority having jurisdiction and in no case less than the time specified.

H. Drain water used for testing from the system after tests are complete. Repair or replace any damages caused by freezing of water left in system at no expense to the University.

I. Testing and balancing of air and hydronic systems specified under other appropriate Sections.

3.10 TERMINATIONS AND CLEANING

A. The Work includes removing tools, scaffolding, surplus materials, barricades, temporary walks, debris and rubbish from the Project promptly upon completion of that portion of the Work. Leave the area of operations completely clean and free of these items.

B. During the course of construction, cap all ducts, pipe and electrical conduit in approved manner to insure adequate protection against entrance of foreign substances.

C. Disconnect, clean and reconnect, whenever necessary, to locate and remove obstructions from any system. Repair or replace any Work damaged in the course of removing said obstructions at no additional cost to University.

3.11 INSTRUCTIONS FOR UNIVERSITY’S PERSONNEL

A. Prior to acceptance of Work and during time designated by University, provide qualified personnel to operate each system for a period of 48 hours during 2 consecutive work days.

B. During operating period, fully instruct University’s personnel in complete operation, adjustment and maintenance of each system.

3.12 PROJECT CLOSEOUT

A. Special tools or safety equipment: Provide one of each tool or piece of safety equipment required for proper operation and maintenance of equipment installed under this Work.

B. Keying: Provide 3 keys for each lock furnished under this Work.

END OF SECTION 220500
 sectional 220518
ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Escutcheons.
   2. Floor plates.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS
A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.
B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.
E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

2.2 FLOOR PLATES
A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
B. Split-Casting Floor Plates: Cast brass with concealed hinge.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
   c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
   d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
   e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
   f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with rough-brass finish.
   g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with rough-brass finish.

2. Escutcheons for Existing Piping:
   a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
   d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
   e. Bare Piping in Unfinished Service Spaces: Split-casting brass type with rough-brass finish.
   f. Bare Piping in Equipment Rooms: Split-casting brass type with rough-brass finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 22 05 18
SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Liquid-in-glass thermometers.
3. Thermowells.
4. Dial-type pressure gages.
5. Gage attachments.
6. Test plugs.
7. Test-plug kits.
8. Sight flow indicators.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Weston
2. Marshal Town
3. Or equal.

C. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ashcroft Inc.
   b. Trerice, H. O. Co.
   c. Or equal.

3. Case: Sealed type, cast aluminum or drawn steel; 5-inch nominal diameter.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
8. Window: Glass.
9. Ring: Metal.
10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.
B. Direct-Mounted, Plastic-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ashcroft Inc.
   b. Miljoco Corporation.
   c. REOTEMP Instrument Corporation.
   d. Or equal.

3. Case: Sealed type, plastic; 5-inch nominal diameter.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
8. Window: Glass.
9. Ring: Metal.
10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range.

C. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ashcroft Inc.
   c. Trerice, H. O. Co.
   d. Weiss Instruments, Inc.
   e. Or equal.

3. Case: Sealed type, cast aluminum or drawn steel; 6-inch nominal diameter with back flange and holes for panel mounting.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
8. Window: Glass.
9. Ring: Metal.
10. Connector Type(s): Union joint, back; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.

D. Remote-Mounted, Plastic-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ashcroft Inc.
   b. Trerice, H. O. Co.
   c. Or equal.


3. Case: Sealed type, plastic; 6-inch nominal diameter with back flange and holes for panel mounting.

4. Element: Bourdon tube or other type of pressure element.

5. Movement: Mechanical, with link to pressure element and connection to pointer.

6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.


8. Window: Glass.

9. Ring: Metal.

10. Connector Type(s): Union joint, threaded, back; with ASME B1.1 screw threads.

11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Trerice, H. O. Co.
   b. Or equal.


3. Case: Cast aluminum; 6-inch nominal size.

4. Case Form: Back angle unless otherwise indicated.

5. Tube: Glass with magnifying lens and blue or red organic liquid.

6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.

7. Window: Glass or plastic.

8. Stem: Aluminum or brass and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.

10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Trerice, H. O. Co.
   c. Weiss Instruments, Inc.
   d. Or equal.

3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.4 THERMOWELLS

A. Thermowells:

2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.5 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
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. Weston
   b. Marshal Town
   c. Or equal.

3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 6-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ashcroft Inc.
   c. Trerice, H. O. Co.
   d. Weiss Instruments, Inc.
   e. Or equal.

3. Case: Liquid-filled type; cast aluminum or drawn steel; 6-inch nominal diameter with back flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.6 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.
2.7 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Peterson Equipment Co., Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Or equal.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.8 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Peterson Equipment Co., Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Or equal.

B. Furnish one test-plug kit(s) containing one thermometer, one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

D. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.

E. Carrying Case: Metal or plastic, with formed instrument padding.

2.9 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Dwyer Instruments, Inc.
2. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
3. Or equal.
B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 150 psig.

E. Minimum Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.
4. Inlet and outlet of each remote domestic water chiller.

L. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.
3.2 CONNECTIONS
A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING
A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE
A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
   1. Liquid-filled, bimetallic-actuated type.
B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be the following:
   1. Liquid-filled, bimetallic-actuated type.
C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be the following:
   1. Liquid-filled, bimetallic-actuated type.
D. Thermometers at inlet and outlet of each remote domestic water chiller shall be the following:
   1. Liquid-filled, bimetallic-actuated type.
E. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE
A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.
B. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F.

3.6 PRESSURE-GAGE SCHEDULE
A. Pressure gages at discharge of each water service into building shall be the following:
   1. Liquid-filled, direct-mounted, metal case.
B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:
   1. Liquid-filled, direct-mounted, metal case.
C. Pressure gages at suction and discharge of each domestic water pump shall be the following:
   1. Liquid-filled, direct-mounted, metal case.
3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 160 psi.

B. Scale Range for Domestic Water Piping: 0 to 100 psi.

END OF SECTION 220519
SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Bronze ball valves.
   2. Iron, single-flange butterfly valves.
   4. Bronze lift check valves.
   5. Bronze swing check valves.
   7. Bronze gate valves.
   8. Bronze globe valves.

B. Related Sections:
   1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
   2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
   3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.
1.4 ACTION SUBMITTALS
   A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE
   A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
   B. ASME Compliance:
      1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
      2. ASME B31.1 for power piping valves.
      3. ASME B31.9 for building services piping valves.
   C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 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 GENERAL REQUIREMENTS FOR VALVES
   A. Refer to valve schedule articles for applications of valves.
   B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
   C. Valve Sizes: Same as upstream piping unless otherwise indicated.
   D. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller.
4. Wrench: For plug valves with square heads.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. NIBCO INC.
   b. Or equal.
2. Description:
   b. CWP Rating: 400 psig.
   c. Body Design: One piece.
   d. Body Material: Bronze.
   e. Ends: Threaded.
   f. Seats: PTFE or TFE.
   g. Stem: Bronze.
   h. Ball: Chrome-plated brass.
   i. Port: Reduced.

B. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. NIBCO INC.
   b. Or equal.
2. Description:
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Three piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Bronze.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. NIBCO INC.
      b. Norriseal; a Dover Corporation company.
      c. Or equal.
   2. Description:
      a. Standard: MSS SP-67, Type I.
      b. CWP Rating: 200 psig.
      c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange. Provide with gear operator for shutoff duty.
      d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
      e. Seat: EPDM.
      f. Stem: One- or two-piece stainless steel.
      g. Disc: Stainless steel.

2.4 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil
      b. Victaulic.
      c. Or equal.
   2. Description:
      a. Standard: MSS SP-67, Type I.
      b. CWP Rating: 175 psig.
      c. Body Material: Coated, ductile iron.
e. Disc: Coated, ductile iron.
f. Seal: EPDM.

2.5 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Or equal.

2. Description:

   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig.
   e. Ends: Threaded.
   f. Disc: Bronze.

2.6 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. NIBCO INC.
   e. Or equal.

2. Description:

   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded.
   f. Disc: Bronze.

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. NIBCO INC.
e. Or equal.

4. Description:
   a. Standard: MSS SP-71, Type I.
   b. CWP Rating: 200 psig.
   c. Body Design: Clear or full waterway.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged.
   f. Trim: Bronze.
   g. Gasket: Asbestos free.

2.7 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. NIBCO INC.
      b. Or equal.
   2. Description:
      a. Standard: MSS SP-80, Type 1.
      b. CWP Rating: 200 psig.
      d. Ends: Threaded (no solder valves allowed).
      e. Stem: Bronze.
      f. Disc: Solid wedge; bronze.
      g. Packing: Asbestos free.
      h. Handwheel: Malleable iron.

2.8 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. NIBCO INC.
      b. Or equal.
   2. Description:
      a. Standard: MSS SP-80, Type 1.
      b. CWP Rating: 200 psig.
      d. Ends: Threaded
      e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. All valves to be installed within 18” of accessible ceiling.

F. Install chainwheels on operators for butterfly valves 6” and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

G. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center guided Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.
3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball valves.
   4. Pump-Discharge Check Valves:
      a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
      b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal seat check valves.
      c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
   4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
   5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   6. For Steel Piping, NPS 5 and Larger: Flanged ends.
   7. For Grooved-End: Valve ends may be grooved.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:
   1. Ball Valves: Three piece, full port, bronze with stainless steel trim.
   2. Bronze Lift Check Valves: Class 125, bronze disc.
   3. Bronze Swing Check Valves: Class 125 bronze disc.

3.6 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Bronze Angle Valves: Class 125 disc.
   3. Ball Valves: Three piece, full port, bronze with stainless steel trim.
   4. Bronze Swing Check Valves: Class 125 bronze disc.
   5. Bronze Gate Valves: Class 125.

END OF SECTION 220523
SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Fastener systems.
   4. Pipe stands.
   5. Pipe positioning systems.
   6. Equipment supports.

1.3 DEFINITIONS
A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS
A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports (Indoors):

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

B. Stainless-Steel Pipe Hangers and Supports (Outdoors):

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.4 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. High-Type, Single-Pipe Stand:
   1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   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.

D. High-Type, Multiple-Pipe Stand:
   1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
   2. Bases: One or more; plastic.
   3. Vertical Members: Two or more protective-coated-steel channels.
   4. Horizontal Member: Protective-coated-steel channel.
   5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

E. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.5 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.
2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fastener System Installation:
   1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer’s written instructions.

D. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. 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.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   4. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
      d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
      e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
   5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
   6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
3.2 EQUIPMENT SUPPORTS
   A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
   B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
   C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 ADJUSTING
   A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
   B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING
   A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
      1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
   B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE
   A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
   B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
   C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
   D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
   E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
   F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
   G. Use padded hangers for piping that is subject to scratching.
   H. Use thermal-hanger shield inserts for insulated piping and tubing.
I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 8): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 42): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 43): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29
SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Stencils.
   5. Valve tags.
   6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.
PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware. Labels to be manufactured by Brady Corporation, or equal.


4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware. Signs and labels to be manufactured by Brady Corporation, or equal.


C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.
H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction. **Labels to be manufactured by Brady Corporation, or equal.**

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions. **Stencils to be manufactured by Brady Corporation, or equal.**
   2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
   3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers. **Tags to be manufactured by Brady Corporation, or equal.**
   1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.
2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing. *Tags to be manufactured by Brady Corporation, or equal.*

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

C. Pipe Label Color Schedule:

<table>
<thead>
<tr>
<th>Legend</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Water</td>
<td>Green</td>
</tr>
<tr>
<td>Hot Water - Domestic Supply</td>
<td>Yellow</td>
</tr>
<tr>
<td>Hot Water - Domestic Return</td>
<td>Yellow</td>
</tr>
<tr>
<td>Hot Water - Heating Supply</td>
<td>Yellow</td>
</tr>
<tr>
<td>Hot Water - Heating Return</td>
<td>Yellow</td>
</tr>
<tr>
<td>Steam Supply (high and low press)</td>
<td>Yellow</td>
</tr>
<tr>
<td>Steam Return</td>
<td>Yellow</td>
</tr>
<tr>
<td>Chilled Water - Supply</td>
<td>Green</td>
</tr>
<tr>
<td>Chilled Water - Return</td>
<td>Green</td>
</tr>
<tr>
<td>Condenser Water - Supply</td>
<td>Green</td>
</tr>
<tr>
<td>Condenser Water - Return</td>
<td>Green</td>
</tr>
<tr>
<td>Gas</td>
<td>Yellow</td>
</tr>
<tr>
<td>Fire - Automatic Sprinklers</td>
<td>Red</td>
</tr>
</tbody>
</table>

3.3 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
3.4 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553
SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:
   1. Domestic hot-water piping.
   2. Domestic recirculating hot-water piping.

B. Related Sections:
   1. Division 22 Section "Plumbing Equipment Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. 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.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations 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. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS


B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
a. Pittsburgh Corning Corporation; Foamglas.
b. Or equal.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
5. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Or equal.
   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

   1. Products: Subject to compliance with requirements, provide one of the following:
      c. Or equal.
   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 SEALANTS

A. Joint Sealants:
1. Joint Sealants for Cellular-Glass and Phenolic Products: Subject to compliance with requirements, provide one of the following:
   c. Pittsburgh Corning Corporation; Pittseal 444.
   d. Or equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements:
   b. Or equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
2.5 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI, Ideal Tape Division; 428 AWF ASJ.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
      c. Compac Corporation; 104 and 105.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
      e. Or equal.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
   2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer’s written instructions, to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable
insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
   1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
   2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
   3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
   4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
   5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of cellular-glass insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.6 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.7 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water:
   1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
      a. Cellular Glass: 1" thick.
   2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
   2. Encasement for piping.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.
   B. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by the University or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify University’s Representative no fewer than 14 days in advance of proposed interruption of water service. Refer to Section 01 31 00 - Coordination.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
   B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."
2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.


E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:
   1. MSS SP-123.
   4. Solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys for pipe less than 2" diameter.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing for pipe 2" diameter or greater”.

2.4 TRANSITION FITTINGS

A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
B. Dielectric Unions:

1. Basis-of-Design Product: Subject to compliance with requirements, provide name or designation or comparable product by one of the following:
   a. Watts; a division of Watts Water Technologies, Inc.
   b. Wilkins; a Zurn company.
   c. Or equal.

3. Pressure Rating: 125 psig minimum at 180 deg F.

C. Dielectric Flanges:

1. Basis-of-Design Product: Subject to compliance with requirements, provide manufacturer’s name; product name or designation or comparable product by one of the following:
   a. Watts; a division of Watts Water Technologies, Inc.
   b. Wilkins; a Zurn company.
   c. Or equal.

3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping" and with
requirements for drain valves and strainers in Division 22 Section "Domestic Water Piping Specialties."

D. Install shutoff valve immediately upstream of each dielectric fitting.
E. Install domestic water piping level and plumb.
F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
H. 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.
I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
J. Install piping to permit valve servicing.
K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
L. Install piping free of sags and bends.
M. Install fittings for changes in direction and branch connections.
N. Install PEX piping with loop at each change of direction of more than 90 degrees.
O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
P. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping."
Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Division 22 Section "Domestic Water Pumps."
R. Install thermometers on inlet and outlet piping from each water heater or heat exchanger. Comply with requirements for thermometers in Division 22 Section "Meters and Gages for Plumbing Piping."
S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION
A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing – 2” diameter and larger: Comply with CDA’s "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing – Less than 2” diameter: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA’s "Copper Tube Handbook."

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION
   A. Install transition couplings at joints of dissimilar piping.
   
   B. Transition Fittings in Underground Domestic Water Piping:
      1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
      2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.5 DIELECTRIC FITTING INSTALLATION
   A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
   
   B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings.
   
   C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.6 HANGER AND SUPPORT INSTALLATION
   A. Comply with requirements for pipe hanger, support products, and installation in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
   
   B. Support vertical piping and tubing at base and at each floor.
   
   C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Water Heaters/Heat Exchangers: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code. Comply with requirements for connection sizes in Division 22 plumbing fixture Sections.
   3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Division 22 Section "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Piping Inspections:
      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
         1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
         2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
      c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
      d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
      e. Comply with the requirements of Section 01 45 00, and 01 45 23.
2. Piping Tests:
   a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
   c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
   f. Prepare reports for tests and for corrective action required.
   g. Comply with the requirements of Section 01 86 00.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports. As required, assist the University’s Test and Balance Consultant to adjust and balance systems to achieve desired results.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Contractor to develop a Method of Procedure (MOP) in cooperation with the University Domestic Water Disinfectant Consultant to implement the necessary tests and procedures to properly disinfect the affected domestic water systems. Final test results
will be submitted to the University, IOR, Engineer or Record, and the Disinfectant Consultant.

2. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

3. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

   b. Fill and isolate system according to either of the following:

      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

   d. Repeat procedures if biological examination shows contamination.

   e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

   a.Flush piping system with clean, potable water until dirty water does not appear at outlets.

   b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:

   1. Hard copper tube, ASTM B 88, Type L; or wrought-copper, solder-joint fittings for smaller than 2" diameter, and brazed for 2" diameter and larger.
E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L; wrought-copper, brazed joints.

F. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:
   1. Stainless-steel Schedule 10 pipe, grooved-joint fittings, and grooved joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
   2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116
SECTION 22 13 16
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Pipe, tube, and fittings.
   2. Specialty pipe fittings.

1.3 PERFORMANCE REQUIREMENTS
A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE
A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.6 PROJECT CONDITIONS
A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify University’s Representative no fewer than two days in advance of proposed interruption of sanitary waste service.
PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service weight.
B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.
B. CISPI, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ANACO-Husky.
      b. No known equal.
   3. Description: Stainless-steel corrugated shield with four stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
C. Cast-Iron, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. MG Piping Products Company.
      b. Or equal.
   3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.
C. Steel Pipe Pressure Fittings:

D. Cast-Iron Flanges: ASME B16.1, Class 125.
   1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.5 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.

D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

E. Copper Pressure Fittings:
   2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
   1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
SANITARY WASTE AND VENT PIPING

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping.

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install steel piping according to applicable plumbing code.

N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
   1. Cut threads full and clean using sharp dies.
   2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
      a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
      b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
      c. Do not use pipe sections that have cracked or open welds.

3.4 HANGER AND SUPPORT INSTALLATION
A. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   3. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
   4. Vertical Piping: MSS Type 8 or Type 42, clamps.
   5. Install individual, straight, horizontal piping runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
   6. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   7. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. **NPS 1-1/4**: 84 inches with 3/8-inch rod.
2. **NPS 1-1/2**: 108 inches with 3/8-inch rod.
3. **NPS 2**: 10 feet with 3/8-inch rod.
4. **NPS 2-1/2**: 11 feet with 1/2-inch rod.
5. **NPS 3**: 12 feet with 1/2-inch rod.
6. **NPS 4 and NPS 5**: 12 feet with 5/8-inch rod.
7. **NPS 6 and NPS 8**: 12 feet with 3/4-inch rod.
8. **NPS 10 and NPS 12**: 12 feet with 7/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. **NPS 2**: 84 inches with 3/8-inch rod.
2. **NPS 3**: 96 inches with 1/2-inch rod.
3. **NPS 4**: 108 inches with 1/2-inch rod.
4. **NPS 6**: 10 feet with 5/8-inch rod.

K. Install supports for vertical stainless-steel piping every 10 feet.

L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. **NPS 1-1/4**: 72 inches with 3/8-inch rod.
2. **NPS 1-1/2 and NPS 2**: 96 inches with 3/8-inch rod.
3. **NPS 2-1/2**: 108 inches with 1/2-inch rod.
4. **NPS 3 and NPS 5**: 10 feet with 1/2-inch rod.
5. **NPS 6**: 10 feet with 5/8-inch rod.
6. **NPS 8**: 10 feet with 3/4-inch rod.

M. Install supports for vertical copper tubing every 10 feet.

N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 VALVE INSTALLATION

A. Comply with requirements in Section 220523 “General Duty Valves for Plumbing Piping”.

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install full-port ball valve for piping NPS 2 and smaller.
3. Install butterfly valve for piping NPS 2-1/2 and larger.
C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge, and as noted on drawings.

3.6 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.

   a. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials.

   a. Isolate test source and allow to stand for four hours.
   b. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

E. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping...
system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

3.8 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
   3. Copper DWV tube, copper drainage fittings, and soldered joints.

C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.

D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
   3. Copper DWV tube, copper drainage fittings, and soldered joints.
      a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.

E. Aboveground, vent piping NPS 5 and larger shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.

F. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 shall be the following:
   1. Galvanized-steel pipe, pressure fittings, and threaded joints.

END OF SECTION 22 13 16
SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Cleanouts.
      2. Floor drains.

1.3 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE
   A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
   B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION
   A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
   B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS
   A. Exposed Metal Cleanouts:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. **Zurn Plumbing Products Group; Specification Drainage Operation.**
   b. Josam Company; Josam Div.
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Josam Company; Blucher-Josam Div.
   f. Or equal.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. **Zurn Plumbing Products Group; Light Commercial Operation.**
   b. Josam Company; Josam Div.
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Or equal.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Required.
7. Closure: Brass plug with straight threads and gasket.
8. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Heavy Duty.

C. Cast-Iron Wall Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. **Zurn Plumbing Products Group; Specification Drainage Operation.**
   b. Josam Company; Josam Div.
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Or equal.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. **Zurn Plumbing Products Group; Light Commercial Operation.**
   b. Josam Company; Josam Div.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

      a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
      b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
      c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

E. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

END OF SECTION 221319
SECTION 22 63 13
MEDICAL GAS PIPING FOR HEALTHCARE FACILITIES

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. Carbon dioxide piping, designated "medical carbon dioxide."
      2. Helium piping, designated "medical helium."
      3. Nitrogen piping, designated "medical nitrogen."
      4. Nitrous oxide piping, designated "medical nitrous oxide."
      5. Oxygen piping, designated "medical oxygen."
      6. Vacuum piping, designated "medical vacuum."

1.3 DEFINITIONS
   A. Medical gas piping systems include medical carbon dioxide, medical helium, medical nitrogen,
      medical nitrous oxide, and medical oxygen for healthcare facility patient care.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For Installer.
   B. Material Certificates: Signed by Installer certifying that medical gas piping materials comply with
      requirements in NFPA 99 for positive-pressure medical gas systems.
   C. Field Quality Control Reports: Brazing certificates.

1.6 QUALITY ASSURANCE
   A. Installer Qualifications:

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the medical gas piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.

C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Medical carbon dioxide operating at 50 to 55 psig.

B. Medical helium operating at 50 to 55 psig.

C. Medical nitrogen operating at 160 to 185 psig.

D. Medical nitrous oxide operating at 50 to 55 psig.

E. Medical oxygen operating at 50 to 55 psig.

F. Medical vacuum operating at 20" Hg.

2.2 PIPES, TUBES, AND FITTINGS

A. Comply with NFPA 99.

B. For all medical gases, all positive pressure medical gas piping, tubing, and fittings shall have been manufacturer cleaned, purged, and sealed for oxygen service, according to CGA G-4.1.

1. Each length of tubing shall be delivered plugged or capped by the manufacturer and kept sealed until prepared for installation.

2. Fittings and other components shall be delivered manufacturer sealed and labeled, and kept sealed until prepared for installation.

C. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue for Type L tube.

D. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type.

E. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.

F. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, full-face type.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

2.3 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.

2.4 VALVES

A. Ball Valves:

2. Description: Three-piece body, brass or bronze.
3. Pressure Rating: 300 psig minimum.
5. Seats: PTFE or TFE.
6. Handle: Lever type with locking device.
7. Stem: Blowout proof with PTFE or TFE seal.
9. Positive pressure medical gas valves, for all medical gas types, shall have been manufacturer cleaned, purged, and sealed for oxygen service, according to CGA G-4.1.
   a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

B. Check Valves:

1. Description: In-line pattern, bronze.
2. Pressure Rating: 300 psig minimum.
5. Positive pressure medical gas valves, for all medical gas types, shall have been manufacturer cleaned, purged, and sealed for oxygen service, according to CGA G-4.1.
   a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
B. Comply with NFPA 99 for installation of medical gas piping.

C. Install piping concealed from view and protected from physical contact by building occupants 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 and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

H. Install piping to permit valve servicing.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and for branch connections.

K. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 VALVE INSTALLATION

A. Install shutoff valve at each connection to gas healthcare equipment and specialties.

B. Install check valves to maintain correct direction of gas flow from healthcare gas supplies.

C. Install pressure regulators on gas piping where reduced pressure is required.

3.3 JOINT CONSTRUCTION

A. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

B. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Continuously purge joint with oil-free, dry nitrogen during brazing.

3.4 HANGER AND SUPPORT INSTALLATION

A. Vertical Piping: MSS Type 8 or Type 42, clamps.

B. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.
C. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

D. Base of Vertical Piping: MSS Type 52, spring hangers.

E. Support horizontal piping within 12 inches of each fitting and coupling.

F. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch-minimum rods.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4: 60 inches with 3/8-inch rod.
2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
4. NPS 1: 96 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.
7. NPS 2: 11 feet with 3/8-inch rod.
8. NPS 2-1/2: 13 feet with 1/2-inch rod.
9. NPS 3: 14 feet with 1/2-inch rod.
10. NPS 3-1/2: 15 feet with 1/2-inch rod.
11. NPS 4: 16 feet with 1/2-inch rod.
12. NPS 5: 18 feet with 1/2-inch rod.
14. NPS 8: 23 feet with 3/4-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

3.5 IDENTIFICATION

A. Install identifying labels and devices for specialty gas piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Install identifying labels and devices for healthcare medical gas piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:

1. Carbon Dioxide: Black or white letters on gray background.
5. Oxygen: White letters on green background or green letters on white background.

3.6 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL GAS

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:
1. Medical Gas Piping Testing Coordination: Perform tests, inspections, verifications, and certification of medical gas piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical vacuum piping systems.

2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
   a. Initial blowdown.
   b. Initial pressure test.
   c. Cross-connection test.
   d. Piping purge test.
   e. Standing pressure test for positive-pressure medical gas piping.
   f. Standing pressure test for vacuum systems.
   g. Repair leaks and retest until no leaks exist.

3. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
   a. Inspections performed.
   b. Procedures, materials, and gases used.
   c. Test methods used.
   d. Results of tests.

C. Remove and replace components that do not pass tests and inspections and retest as specified above.

D. Prepare test and inspection reports.

3.7 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties until installation.

C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.8 PIPING SCHEDULE

A. Medical Gas Piping except Medical Nitrogen Piping Larger Than NPS 3 and Operating at More Than 185 psig: Type L, copper tube; wrought-copper fittings; and brazed joints.

3.9 VALVE SCHEDULE

A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.

END OF SECTION 22 63 13
DIVISION 23
HEATING, VENTILATING AND AIR CONDITIONING
SECTION 230510 – BASIC MECHANICAL MATERIALS AND METHODS

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. The intent of Division 21, 22, and 23 Specifications and Drawings is to provide complete and workable mechanical systems as shown, specified and required by applicable codes. Include all work specified in Division 21, 22 and 23 and shown on the Drawings, including appurtenances, connections, demolition, appliances, and incidental accessories to make work complete and ready for operation.

B. The Drawings that accompany the Division 21, 22, and 23 Specifications are diagrammatic. They do not show every offset, pipe/duct fitting, or elbow that may be required to install work in the space provided and avoid conflicts. Locations of all items not definitely fixed by dimensions are approximate only. Coordinate Division 21, 22, and 23 work as required by Division 01.

C. Include minor details not usually shown or specified, but necessary for proper installation and operation of a system or piece of equipment in work and in bid price, the same as if specified or shown.

1.3 ENFORCEABLE CODES

A. The code publications listed below form a part of this specification. This list is not exclusive, local and other codes may also apply:

1. 2013 California Administrative Code (CAC), Part 1, Title 24, California Code of Regulations (CCR).
4. 2013 California Mechanical Code (CMC), Part 4, Title 24, CCR, (Based on the 2009 Uniform Mechanical Code).
5. 2013 California Plumbing Code (CPC), Part 5, Title 24, CCR, (Based on the 2009 Uniform Plumbing Code).
6. 2013 California Fire Code (CFC), Part 9, Title 24, CCR, (Based on the 2009 International Fire Code).

1.4 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subjected to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber
   2. NBR: Acrylonitrile-butadiene rubber.
B. Coordination Drawings: Each trade shall be responsible for their own respective coordination drawing effort with the HVAC contractor being the coordination effort team leader. Drawings shall be electronic (AutoCAD) and each trade shall have the ability to coordinate electronically (xref) into each other’s drawings for collision checking and spatial conditions. When coordination effort is completed contractors shall sign drawings demonstrating that they are buildable shop drawings. Coordination drawings can also be used as the contract “as-builts” at project completion.

C. Submit required copies of shop drawings, product data, samples, schedules and reports as required by individual Division 21, 22, and 23 Sections.

1.7 QUALITY ASSURANCE

A. Provide Work and materials in accordance with the latest rules and regulations of the California State Fire Marshal and the California State Department of Public Health, Titles 17 and 24; the California Plumbing Code and California Mechanical Code, IAPMO; the NFPA Pamphlet 13, 14, 24, 291; and other applicable laws or regulations.

B. Where the standards of the drawing and specifications for materials and/or workmanship are higher than the requirements of the regulations cited above, the drawings and specifications shall take precedence; otherwise the regulations shall govern.

C. Provide materials and apparatus that bear the UL label where such label is applicable.

D. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.8 DELIVERY, STORAGE AND HANDLING

A. Protect materials from corrosion and breakage. Store materials above grade. Provide appropriate covering.

B. Replace any materials which are damaged or degraded by improper storage with new.

1.9 SITE VISITATION

A. Visit the site prior to bidding and become familiar with existing conditions and other factors which may affect the execution of the work. Include all related cost in the initial bid proposal.

1.10 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08.
D. Coordinate all equipment, ductwork, and piping layout with other trades.

1.11 WARRANTY

A. Comply with the requirements of Division 01.

B. Provide manufacturer’s written warranties covering defects in materials and workmanship of products and equipment utilized for this project.

C. Each complete system shall be warranted for a period of one year from the date of Substantial Completion.

D. Each system shall be free of defects in materials and workmanship, and shall perform satisfactorily under all conditions of load or service.

E. The warranties shall provide that all additional controls, protective devices, or equipment be provided as necessary for operation of the system or equipment.

F. Replace or repair faulty materials or workmanship at no additional cost to the University.

G. See specific sections for additional equipment warranty items.

1.12 OPERATING INSTRUCTIONS MANUALS

A. Provide 2 copies of complete Manual, bound in booklet form, plus an electronic copy on permanent storage media. Each manual shall contain the following information:

1. List of all equipment with manufacturer’s name, model number, and local representative, service facilities, and the normal channel of supply for each item.
2. Manufacturer’s literature describing each item of equipment with detailed parts list.
3. Equipment service schedules and IOMs.
4. Equipment warranties.
5. Certificates of Inspection.
6. Record Blueprints and related Shop Drawings.
7. Air and Water Systems Balance Reports.

1.13 RECORD DRAWINGS

A. Maintain at the site an up to date set of prints of Engineering Drawings which clearly indicate (by shading, coloring or some other acceptable method) the daily extent of Work installed.

B. Indicate on Drawings changes in elevation, location, or size of material deviating from original design.

C. Clearly indicate any dimension changes in elevation, location, size or material, and offsets for valves.

D. Locate all underground, concealed or buried piping by two or more dimensions per turn of pipe between each direction change.

E. Show all elevations (invert or centerline) with the point of elevation change clearly located.
F. Number and letter valves to correspond with numbers and letters of valve charts.

G. At conclusion of contract work, provide the University Representative with a complete set of reproducible drawings with all changes clearly marked to reflect as-built conditions. These drawings shall be labeled “As-Builts”. Updated Coordination drawings can be used as the contract “As-Built” drawings at project completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer’s names and model numbers used for materials, processes, or equipment in Division 21, 22, and 23 provide the basis for design and the minimum standards of quality, utility and appearance.

2.2 SUBSTITUTIONS

A. For substitutions see Division 01.

B. If not specified in Division 01:
   1. Substitutions only from list provided.
   2. Contractor is responsible for all alterations required to make substituted product work.
   3. Contractor is responsible for all coordination of other trades required by substitution.
   4. Contractor is responsible for any engineering and structural or seismic modifications to the equipment supports and structure, etc.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Comply with the requirements of Division 02.

B. Remove fixtures and equipment not to remain in service as shown on Drawings or as required. This includes the removal of associated appurtenances and supports.

C. Patch, cap, or repair existing work affected by this demolition in concealed spaces within six (6) inches of a live main or branch.

D. Deliver removed materials to be retained by the University for storage on-site as directed by the University Representative. Properly dispose of all other removed material off site.

E. Where hazardous and carcinogenic materials are encountered, stop the work immediately and notify the University Representative.

3.2 INSTALLATION

A. General Installation Method:
   1. Examine site related work and surfaces before starting work of any Section:
a. Report to University Representative, in writing, conditions which will prevent proper execution of this work.
b. Beginning work of any Section without reporting unsuitable conditions to University’s Representative constitutes acceptance of conditions by Contractor.
c. Perform any required removal, repair, or replacement of any unacceptable work caused by unsuitable conditions at no additional cost to The University.

B. Provide a complete and properly operating system for each item of equipment called for under this work. Install in accordance with equipment manufacturer’s written instructions, published standards, the best industry practices, and the Contract Documents.

C. Make installations in a neat, finished, and safe and professional manner. Install all materials and equipment in accordance with manufacturer’s required or recommended procedures.

D. Coordinate with shop drawings for work done by other trades.

E. Verify all dimensions by field measurements.

F. Arrange for chases, sleeves, and openings in other building components during progress of construction, to allow for installation of ductwork and piping.

G. Coordinate the installation of required supporting devices and sleeves.

H. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations. Maintain all manufacturer required service clearances.

I. Install HVAC equipment to allow right of way for piping installed at required slope.

J. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

K. Install systems, materials, and equipment to comply with approved submittal data. Comply with arrangements indicated by the Drawings, recognizing that portions of the work are shown only in diagrammatic form.

L. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.

3.3 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09.

B. If not specified in Division 09:
   1. In general, paint all exposed ductwork, insulation, and piping.
   2. Materials are to be clean, dry, free of oxidation residues, and within the temperature range specified by the paint manufacturer.
   3. Degrease and etch all galvanized products not factory prepared (Galvanneal coating) for painting.

C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
3.4 PIPE EXPANSION, CONTRACTION, VIBRATION

A. Install pipe connections to allow for movement of piping during expansion, contraction, or vibration. Provide expansion loops, flex connections, and expansion joints with proper anchors and guides as required or where shown on Drawings. Anchors and guides shall be subject to review.

B. Motor driven equipment shall operate quietly and shall be free of vibration.

C. Construct and brace metal partitions, ducts, sheet metal housings, and similar items so that there will be no vibration or rattling when the system is in operation.

D. Design and construct connections to the equipment so that noise and vibration will not reach the conditioned areas through ducts, conduits, piping, and sheet metal of the building construction.

3.5 MANUFACTURER’S IDENTIFICATION

A. Manufacturer’s nameplate, name, or trademark shall be permanently affixed to all equipment and materials furnished under this Specification. The nameplates of Subcontractor or Distributor are not acceptable.

3.6 SCAFFOLDING, RIGGING, AND HOISTING

A. Contractor is responsible for all scaffolding, rigging, and hoisting equipment required for the installation of materials and equipment. Coordinate rigging and scaffolding with other trades.

B. Where access openings must be cut in the structure or additional bracing must be added to the structure, contractor is responsible for all work required to repair the structure back to original conditions. See CUTTING AND PATCHING below.

C. Protect all roofs, walls, floors, and other finished surfaces from damage when installing large equipment.

D. For additional requirements of this work, see Division 01.

3.7 CUTTING AND PATCHING

A. Comply with requirements of Division 01.

B. Cut completed Work only where sleeves, openings, chases, and similar items were inadvertently omitted and only with specific permission of the University Representative. In no case shall reinforcing steel be cut without specific written permission of the University Representative.

C. Provide sleeves, caps, plates, escutcheons, flashing, and similar items required to fill or close the openings.

D. Provide final grouting, concrete, asphalt, masonry, painting, and other materials as required to complete patch work.
E. Where cutting occurs on any building fire or smoke compartment separation, repair to maintain the integrity of the separation, including all necessary automatic dampers and UL approved through penetration systems.

F. Where cutting and patching occurs in streets, sidewalks, alleys, and the like, cooperate fully with the University Representative and municipal or other government bodies to match existing materials.

3.8 OPERATION BY UNIVERSITY

A. The University may require operation of parts or all of respective installations prior to final acceptance. Cost of utilities for such operation shall be paid by The University.

3.9 TEST AND ADJUSTMENTS

A. Labor, materials, instruments, and power required for testing provided under respective Sections for Work under that Section.

B. Test shall be performed as specified or as required by regulating authority having jurisdiction. Submit to University Representative certification that tests have been performed in accordance with Contract Documents.

C. Pressure test piping before connection to equipment. No piping, equipment, or accessories shall be subjected to pressures exceeding their indicated rating.

D. Repair or replace defective Work and repeat tests until particular systems, and component parts thereof, receive approval of University Representative and regulating authority.

   1. Any damages resulting from test shall be repaired and damaged materials replaced at no cost to The University.

E. Equipment and systems which normally operate during certain seasons of the year shall be tested during the appropriate season.

   1. Perform test on individual equipment, systems, and their controls.
   2. Whenever the equipment or system under test is inter-related with, and depends upon the operation of other equipment or systems and their controls for proper operation, functioning, and performance, the latter shall be operated simultaneously with equipment or system being tested.

F. No piping or ductwork shall be closed up, furred in, or covered before testing. Notify regulating authority and University Representative 3 days before test are to be conducted.

G. Test all systems as specified under various applicable Sections. Duration of test shall be determined by the authority having jurisdiction and in no case less than the time specified.

H. Drain water used for testing from the system after test are complete. Repair or replace any damages caused by freezing of water left in system at no expense to the University.

I. Test and balancing of air and hydronic systems specified under other appropriate Sections.
3.10 TERMINATIONS AND CLEANING

A. The Work includes removing tools, scaffolding, surplus materials, barricades, temporary walks, debris, and rubbish from the Project promptly upon completion of that portion of the Work. Leave the area of operations completely clean and free of these items.

B. During the course of construction, cap all ducts, pipes, and electrical conduits in approved manner to insure adequate protection against entrance of foreign substances.

C. Disconnect, clean, and reconnect, whenever necessary, to locate and remove obstructions from any system. Repair or replace any Work damaged in the course of removing said obstructions at no additional cost to the University.

3.11 INSTRUCTIONS FOR UNIVERSITY PERSONNEL

A. Prior to acceptance of Work and during time designated by the University Representative, provide qualified personnel to operate each system for a period of 48 hours during 2 consecutive work days.

B. During operating period, fully instruct University personnel in complete operation, adjustment, and maintenance of each system.

C. See specific sections for additional startup and training procedures.

3.12 PROJECT CLOSEOUT

A. Special tools or safety equipment: Provide one of each tool or piece of safety equipment required for proper operation and maintenance of equipment installed under this Work.

B. KEYING: Provide 3 keys for each lock furnished under this Work.

END OF SECTION 230500
SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer’s factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION
A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS
A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS
A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. **Grounding**: Provide shaft ground rings on all motors for bearing protection.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers:
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

D. **Grounding**: Provide shaft ground rings on all motors for bearing protection.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513
SECTION 230519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Bimetallic-actuated thermometers.
      2. Liquid-in-glass thermometers.
      3. Thermowells.
      4. Dial-type pressure gages.
      5. Gage attachments.
      6. Test plugs.
      7. Test-plug kits.
      8. Sight flow indicators.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS
   A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS
   A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1. Weston
      2. Marshal Town
      3. Or equal.

C. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ashcroft Inc.
   b. Trerice, H. O. Co.
   c. Or equal.


3. Case: Sealed type, cast aluminum or drawn steel; 5-inch nominal diameter.

4. Element: Bourdon tube or other type of pressure element.

5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.

6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.


8. Window: Glass.

9. Ring: Metal.

10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.

11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range.
B. Direct-Mounted, Plastic-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ashcroft Inc.
   b. Miljoco Corporation.
   c. REOTEMP Instrument Corporation.
   d. Or equal.

3. Case: Sealed type, plastic; 5-inch nominal diameter.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
8. Window: Glass.
9. Ring: Metal.
10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range.

C. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ashcroft Inc.
   c. Trerice, H. O. Co.
   d. Weiss Instruments, Inc.
   e. Or equal.

3. Case: Sealed type, cast aluminum or drawn steel; 6-inch nominal diameter with back flange and holes for panel mounting.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
8. Window: Glass.
9. Ring: Metal.
10. Connector Type(s): Union joint, back; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
a. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range.

D. Remote-Mounted, Plastic-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Trerice, H. O. Co.
   b. Ashcroft Inc.
   c. Or equal.

3. Case: Sealed type, plastic; 6-inch nominal diameter with back flange and holes for panel mounting.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
8. Window: Glass.
9. Ring: Metal.
10. Connector Type(s): Union joint, threaded, back; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Trerice, H. O. Co.
   b. Or equal.

3. Case: Cast aluminum; 6-inch nominal size.
4. Case Form: Back angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
2.4 THERMOWELLS

A. Thermowells:

2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.
2.5 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

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. Weston
   b. Marshal Town
   c. Or equal.

3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 6-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ashcroft Inc.
   c. Trerice, H. O. Co.
   d. Weiss Instruments, Inc.
   e. Or equal.

3. Case: Liquid-filled type; cast aluminum or drawn steel; 6-inch nominal diameter with back flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.6 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.7 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Peterson Equipment Co., Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Or equal.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.8 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Peterson Equipment Co., Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Or equal.

B. Furnish one test-plug kit(s) containing one thermometer, one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

D. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.

E. Carrying Case: Metal or plastic, with formed instrument padding.

2.9 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Dwyer Instruments, Inc.
2. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
3. Or equal.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 150 psig.

E. Minimum Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubby in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.
4. Inlet and outlet of each remote domestic water chiller.
L. Install pressure gages in the following locations:
   1. Building water service entrance into building.
   2. Inlet and outlet of each pressure-reducing valve.
   3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS
A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING
A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE
A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
   1. Liquid-filled, bimetallic-actuated type.
B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be the following:
   1. Liquid-filled, bimetallic-actuated type.
C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be the following:
   1. Liquid-filled, bimetallic-actuated type.
D. Thermometers at inlet and outlet of each remote domestic water chiller shall be the following:
   1. Liquid-filled, bimetallic-actuated type.
E. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE
A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.
B. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F.

3.6 PRESSURE-GAGE SCHEDULE
A. Pressure gages at discharge of each water service into building shall be the following:
   1. Liquid-filled, direct-mounted, metal case.
B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:
1. Liquid-filled, direct-mounted, metal case.

C. Pressure gages at suction and discharge of each domestic water pump shall be the following:
   1. Liquid-filled, direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 160 psi.

B. Scale Range for Domestic Water Piping: 0 to 100 psi.

END OF SECTION 230519
SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Bronze ball valves.
   2. Iron, single-flange butterfly valves.
   4. Bronze lift check valves.
   5. Bronze swing check valves.
   7. Bronze gate valves.
   8. Bronze globe valves.

B. Related Sections:
   1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
   2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
   3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 DEFINITIONS

A. CWP:  Cold working pressure.

B. EPDM:  Ethylene propylene copolymer rubber.

C. NBR:  Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS:  Nonrising stem.

E. OS&Y:  Outside screw and yoke.

F. RS:  Rising stem.

G. SWP:  Steam working pressure.
1.4 ACTION SUBMITTALS
   A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE
   A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
   B. ASME Compliance:
      1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
      2. ASME B31.1 for power piping valves.
      3. ASME B31.9 for building services piping valves.
   C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 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 GENERAL REQUIREMENTS FOR VALVES
   A. Refer to valve schedule articles for applications of valves.
   B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
   C. Valve Sizes: Same as upstream piping unless otherwise indicated.
   D. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller.
4. Wrench: For plug valves with square heads.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. NIBCO INC.
   b. Or equal.

2. Description:
   b. CWP Rating: 400 psig
   c. Body Design: One piece.
   d. Body Material: Bronze.
   e. Ends: Threaded.
   f. Seats: PTFE or TFE.
   g. Stem: Bronze.
   h. Ball: Chrome-plated brass.
   i. Port: Reduced.

B. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. NIBCO INC.
   b. Or equal.
2. **Description:**
   
b. SWP Rating: 150 psig
c. CWP Rating: 600 psig
d. Body Design: Three piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

2.3 **IRON, SINGLE-FLANGE BUTTERFLY VALVES**

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      
a. NIBCO INC.
b. Norriseal; a Dover Corporation company.
c. Or equal.

   2. **Description:**
      
a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange. Provide with gear operator for shutoff duty.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.4 **IRON, GROOVED-END BUTTERFLY VALVES**

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      
a. Victaulic.
b. Anvil.
c. Or equal.

   2. **Description:**
      
a. Standard: MSS SP-67, Type I.
b. CWP Rating: 175 psig
c. Body Material: Coated, ductile iron.
2.5 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Or equal.

2. Description:
   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig
   e. Ends: Threaded.
   f. Disc: Bronze.

2.6 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. NIBCO INC.
   e. Or equal.

2. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig
   c. Body Design: Horizontal flow.
   e. Ends: Threaded.
   f. Disc: Bronze.

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. NIBCO INC.
4. Description:
   a. Standard: MSS SP-71, Type I.
   b. CWP Rating: 200 psig
   c. Body Design: Clear or full waterway.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged.
   f. Trim: Bronze.
   g. Gasket: Asbestos free.

2.7 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. NIBCO INC.
   b. Or equal.

2. Description:
   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig
   d. Ends: Threaded
   e. Stem and Disc: Bronze.
   f. Packing: Asbestos free.
   g. Handwheel: Malleable iron.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.
3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for butterfly valves 6” and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center guided Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

   1. Shutoff Service: Ball valves.
   4. Pump-Discharge Check Valves:
      a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
      b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal seat check valves.
      c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4 Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
   4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
   5. For Steel Piping, NPS 2-1/2 to NPS 4 Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End: Valve ends may be grooved.

3.5 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Bronze Angle Valves: Class 125, bronze disc.
   3. Ball Valves: Three piece, full regular port, bronze with brass stainless-steel trim.
   4. Bronze Swing Check Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:
   1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
   2. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.
   5. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: [175] [300] CWP.
   6. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
   7. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.

3.6 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Bronze Angle Valves: Class 125, bronze disc.
   3. Ball Valves: Three piece, full regular port, bronze with brass stainless-steel trim.
   4. Bronze Swing Check Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:
   1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
   2. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.
   5. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.

END OF SECTION 230523
SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fastener systems.
4. Pipe stands.
5. Pipe positioning systems.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.
1.5 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: Show fabrication and installation details for the following; include Product Data for components:
      1. Trapeze pipe hangers.
      2. Pipe stands.

1.6 INFORMATIONAL SUBMITTALS
   A. Welding certificates.

1.7 QUALITY ASSURANCE
   A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS
   A. Carbon-Steel Pipe Hangers and Supports:
      1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
      2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
      3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
      4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   B. Stainless-Steel Pipe Hangers and Supports:
      1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
      2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.4 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. High-Type, Single-Pipe Stand:
   1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   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.

D. High-Type, Multiple-Pipe Stand:
   1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
   2. Bases: One or more; plastic.
   3. Vertical Members: Two or more protective-coated-steel channels.
   4. Horizontal Member: Protective-coated-steel channel.
   5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

E. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.
PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

C. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer’s written instructions.

D. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section “Roof Accessories” for curbs.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


H. 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.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
3.3 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.4 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Beam Clamp Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   2. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 23 05 29
PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Equipment labels.
      2. Warning signs and labels.
      3. Pipe labels.
      4. Stencils.
      5. Valve tags.
      6. Warning tags.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Samples: For color, letter style, and graphic representation required for each identification material and device.
   C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
   D. Valve numbering scheme.
   E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION
   A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
   B. Coordinate installation of identifying devices with locations of access panels and doors.
   C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS
   A. Plastic Labels for Equipment:
1. **Labels to be manufactured by Brady Corporation, or equal.**
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
4. Background Color: Black.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. 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.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 **WARNING SIGNS AND LABELS**

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware. **Labels to be manufactured by Brady Corporation, or equal.**


C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.
2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction. **Labels to be manufactured by Brady Corporation, or equal.**

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions. **Stencils to be manufactured by Brady Corporation, or equal.**
   2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
   3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers. **Tags to be manufactured by Brady Corporation, or equal.**
   1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing. **Tags to be manufactured by Brady Corporation, or equal.**
1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as “DANGER,” “CAUTION,” or “DO NOT OPERATE.”

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.
B. Locate equipment labels where accessible and visible.
C. Pipe Label Color Schedule:

<table>
<thead>
<tr>
<th>Legend</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Water</td>
<td>Green</td>
</tr>
<tr>
<td>Hot Water - Domestic Supply</td>
<td>Yellow</td>
</tr>
<tr>
<td>Hot Water - Domestic Return</td>
<td>Yellow</td>
</tr>
<tr>
<td>Hot Water - Heating Supply</td>
<td>Yellow</td>
</tr>
<tr>
<td>Hot Water - Heating Return</td>
<td>Yellow</td>
</tr>
<tr>
<td>Steam Supply (high and low press)</td>
<td>Yellow</td>
</tr>
<tr>
<td>Steam Return</td>
<td>Yellow</td>
</tr>
<tr>
<td>Chilled Water - Supply</td>
<td>Green</td>
</tr>
<tr>
<td>Chilled Water - Return</td>
<td>Green</td>
</tr>
<tr>
<td>Condenser Water - Supply</td>
<td>Green</td>
</tr>
<tr>
<td>Condenser Water - Return</td>
<td>Green</td>
</tr>
<tr>
<td>Gas</td>
<td>Yellow</td>
</tr>
<tr>
<td>Fire - Automatic Sprinklers</td>
<td>Red</td>
</tr>
</tbody>
</table>

3.3 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.4 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required. Warning tags shall comply with CAL-OSHA regulations.
END OF SECTION 230553
SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Balancing Air Systems:
      a. Constant-volume air systems.
   2. Balancing Hydronic Piping Systems:
      a. Constant-flow hydronic systems.
      b. Primary-secondary hydronic systems.

1.3 DEFINITIONS

C. TAB: Testing, adjusting, and balancing.
D. TABB: Testing, Adjusting, and Balancing Bureau.
E. TAB Specialist: An entity engaged by the University to perform TAB Work.
F. TAB Team: All contractors involved with systems to be tested and balanced, or affecting TAB process.

1.4 ACTION SUBMITTALS

A. LEED Submittals:
   1. Air-Balance Report for Prerequisite IEQ 1: Documentation of work performed for ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
   2. TAB Report for Prerequisite EA 2: Documentation of work performed for ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

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TESTING, ADJUSTING, AND BALANCING FOR HVAC
1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.


D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:
   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.
   5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. **TAB Specialist will be retained by the University. Contractor shall coordinate and assist TAB in executing this section of work.**

B. TAB Specialist Qualifications: Engage a TAB entity certified by AABC or NEBB.
   1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
   2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB or AABC.

C. TAB Conference: **TAB Team and TAB Specialist to meet** with the University's Representative on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide 15 days' advance notice of scheduled meeting time and location.
   1. Agenda Items:
      b. The TAB plan.
      c. Coordination and cooperation of trades and subcontractors.
      d. Coordination of documentation and communication flow.

D. Certify TAB field data reports and perform the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
E. TAB Report Forms: Use standard TAB contractor's forms approved by the Engineer of Record.

F. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

G. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

H. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.8 COORDINATION

A. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Perform HVAC TAB prior to start of construction. See drawings and subsection 3.11 below.

B. TAB Team and TAB Specialist will examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

C. TAB Team and TAB Specialist will examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

D. Examine the approved submittals for HVAC systems and equipment.

E. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
F. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

G. Examine equipment performance data including fan and pump curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

H. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

I. Examine test reports specified in individual system and equipment Sections.

J. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

L. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

M. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

O. Examine system pumps to ensure absence of entrained air in the suction piping.

P. Examine operating safety interlocks and controls on HVAC equipment.

Q. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. **TAB Team and TAB Specialist to prepare** a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. **TAB Team will assist TAB Specialist to verify** the following:
   1. Permanent electrical-power wiring is complete.
   2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. **As required, TAB Team will assist the TAB Specialist to perform** testing and balancing procedures on each system according to the procedures contained in AABC’s "National Standards for Total System Balance" or SMACNA’s "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. **TAB Team** to cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. **TAB Team will mark** equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. **As required, the TAB Team will assist the TAB Specialist with the following:**

1. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
2. Prepare schematic diagrams of systems' "as-built" duct layouts.
3. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
4. Check airflow patterns from the outdoor-air louver dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
5. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
6. Verify that motor starters are equipped with properly sized thermal protection.
7. Check dampers for proper position to achieve desired airflow path.
8. Check for airflow blockages.
9. Check condensate drains for proper connections and functioning.
10. Check for proper sealing of air-handling-unit components.
11. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."
3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
   a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:
   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from University’s Representative for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.
   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. As required, TAB Team will assist the TAB Specialist with the following:

1. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
2. Prepare schematic diagrams of systems' "as-built" piping layouts.
3. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   a. Open all manual valves for maximum flow.
   b. Check liquid level in expansion tank.
   c. Check makeup water-station pressure gage for adequate pressure for highest vent.
   d. Check flow-control valves for specified sequence of operation, and set at indicated flow.
   e. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
   f. Set system controls so automatic valves are wide open to heat exchangers.
   g. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
   h. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. As required, TAB Team will assist the TAB Specialist with the following:

1. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
   a. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
b. If impeller sizes must be adjusted to achieve pump performance, obtain approval from University’s Representative and comply with requirements in Division 23 Section "Hydronic Pumps."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

   a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

4. Report flow rates that are not within plus or minus 10 percent of design.

5. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

6. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

7. Set calibrated balancing valves, if installed, at calculated presettings.

8. Measure flow at all stations and adjust, where necessary, to obtain first balance.

   a. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

9. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

10. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

    a. Determine the balancing station with the highest percentage over indicated flow.

    b. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.

    c. Record settings and mark balancing devices.

11. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems’ pressures and temperatures including outdoor-air temperature.

12. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

13. Check settings and operation of each safety valve. Record settings.

3.8 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

   A. As required, TAB Team will assist the TAB Specialist with the following:

      1. Balance the primary circuit flow first and then balance the secondary circuits.

3.9 PROCEDURES FOR HEAT EXCHANGERS

   A. As required, TAB Team will assist the TAB Specialist with the following:

      1. Measure water flow through all circuits.

      2. Adjust water flow to within specified tolerances.

      3. Measure inlet and outlet water temperatures.

      4. Measure inlet steam pressure.
5. Check settings and operation of safety and relief valves. Record settings.

3.10 PROCEDURES FOR MOTORS

A. As required, TAB Team will assist the TAB Specialist with the following:
   1. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
      2. Manufacturer's name, model number, and serial number.
      5. Efficiency rating.
      6. Nameplate and measured voltage, each phase.
      7. Nameplate and measured amperage, each phase.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.11 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. As required, TAB Team will assist the TAB Specialist with the following:
   1. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
   2. Measure and record the operating speed, airflow, and static pressure of each fan.
   3. Measure motor voltage and amperage. Compare the values to motor nameplate information.
   4. Check the refrigerant charge.
   5. Check the condition of filters.
   6. Check the condition of coils.
   7. Check the operation of the drain pan and condensate-drain trap.
   8. Check bearings and other lubricated parts for proper lubrication.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
   1. New filters are installed.
   2. Coils are clean and fins combed.
   3. Drain pans are clean.
   4. Fans are clean.
   5. Bearings and other parts are properly lubricated.
   6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.

2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.

3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

4. Balance each air outlet.

3.12 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.13 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.14 FINAL REPORT

A. General: TAB Specialist will prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
   a. Indicated versus final performance.
   b. Notable characteristics of systems.
   c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
   a. Settings for outdoor-, return-, and exhaust-air dampers.
   b. Conditions of filters.
   c. Cooling coil, wet- and dry-bulb conditions.
   d. Face and bypass damper settings at coils.
   e. Fan drive settings including settings and percentage of maximum pitch diameter.
   f. Inlet vane settings for variable-air-volume systems.
   g. Settings for supply-air, static-pressure controller.
   h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Sheave make, size in inches, and bore.
   i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   j. Number, make, and size of belts.
   k. Number, type, and size of filters.
2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
   a. Total air flow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat-coil static-pressure differential in inches wg.
   g. Cooling-coil static-pressure differential in inches wg.
   h. Heating-coil static-pressure differential in inches wg.
   i. Outdoor airflow in cfm.
   j. Return airflow in cfm.
   k. Outdoor-air damper position.
   l. Return-air damper position.
   m. Vortex damper position.

F. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and size.
   e. Model number and serial number.
   f. Water flow rate in gpm.
   g. Water pressure differential in feet of head or psig.
   h. Required net positive suction head in feet of head or psig.
   i. Pump rpm.
   j. Impeller diameter in inches.
   k. Motor make and frame size.
   l. Motor horsepower and rpm.
   m. Voltage at each connection.
   n. Amperage for each phase.
   o. Full-load amperage and service factor.
   p. Seal type.

2. Test Data (Indicated and Actual Values):
   a. Static head in feet of head or psig.
   b. Pump shutoff pressure in feet of head or psig.
   c. Actual impeller size in inches.
   d. Full-open flow rate in gpm.
   e. Full-open pressure in feet of head or psig.
   f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

G. Instrument Calibration Reports:

1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.
SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following duct services:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, concealed return located in unconditioned space.

B. Related Sections:
   1. Division 23 Section "HVAC Equipment Insulation."
   2. Division 23 Section "HVAC Piping Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION
A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING
A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS
B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide the following:
   a. CertainTeed Corp.; SoftTouch Duct Wrap.
   b. Johns Manville; Microlite.
   c. Owens Corning; SOFTR All-Service Duct Wrap.
   d. Or equal.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide the following:
   c. Or equal.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:
   b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   c. Or equal.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
2.3 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.4 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   e. Or equal.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide the following:
   a. ABI, Ideal Tape Division; 491 AWF FSK.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   c. Compac Corporation; 110 and 111.
   d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
   e. Or equal.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
2.5 SECUREMENTS

A. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135 inch diameter shank, length to suit depth of insulation indicated.

   a. Products: Subject to compliance with requirements, provide the following:

      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.
      5) Or equal.

B. Wire: 0.080-inch nickel-copper alloy.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      b. Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" and fire-resistive joint sealers.

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer’s recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Impale insulation over pins and attach speed washers.
   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed return located in unconditioned space.
   4. Indoor, exposed return located in unconditioned space.

B. Items Not Insulated:
   1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
   2. Factory-insulated flexible ducts.
   3. Factory-insulated plenums and casings.
   4. Flexible connectors.
   5. Vibration-control devices.
   6. Factory-insulated access panels and doors.

3.7 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Concealed, round and flat-oval, return-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

C. Concealed, rectangular, supply-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

D. Concealed, rectangular, return-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

END OF SECTION 230713
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:
   1. Chilled-water and brine piping, indoors.
   2. Heating hot-water piping, indoors.

B. Related Sections:
   1. Division 23 Section "HVAC Equipment Insulation."
   2. Division 23 Section "Duct Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations 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. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS


B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Pittsburgh Corning Corporation; Foamglas.
      b. Or equal.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide the following:
      a. CertainTeed Corp.; SoftTouch Duct Wrap.
      b. Johns Manville; Microlite.
      c. Owens Corning; SOFTR All-Service Duct Wrap.
      d. Or equal.

G. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide the following:
      a. Fibrex Insulations Inc.; Coreplus 1200.
      b. Johns Manville; Micro-Lok.
      c. Manson Insulation Inc.; Alley-K.
      d. Owens Corning; Fiberglas Pipe Insulation.
      e. Or equal.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
1. Products: Subject to compliance with requirements, provide the following:
   b. Or equal.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide the following:
   c. Or equal.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."


1. Products: Subject to compliance with requirements, provide the following:
   c. Or equal.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide the following:
2.4 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

2.5 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide the following:
   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   e. Or equal.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer’s recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
      a. For below-ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer’s written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
   5. Handholes.
   6. Cleanouts.
3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.

3.7 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.8 INDOOR PIPING INSULATION SCHEDULE

A. Chilled Water and Brine, 42 Deg F and below:

1. NPS 3 and Smaller: Insulation shall be one of the following:
   a. Mineral-Fiber, Preformed Pipe, Type I: 1.0 inch thick.

2. NPS 4 to NPS 12: Insulation shall be one of the following:
   a. Cellular Glass: 2 inches thick.
   b. Mineral-Fiber, Preformed Pipe, Type I 1-1/2 inches thick.

B. Heating-Hot-Water Supply and Return, 220 degF and below:

1. NPS 1 and Larger: Insulation shall be one of the following:
   a. Cellular Glass: 3 inches thick.
   b. Mineral-Fiber, Preformed Pipe, Type I or II: 2 inches thick.

END OF SECTION 230719
SECTION 23 09 00 - BUILDING AUTOMATION CONTROL SYSTEM (BACS)

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 WORK INCLUDED:

A. Control sequences of operation shall be as shown in Drawings or as noted herein. Drawings of systems are diagrammatic only and any apparatus not shown, such as relays, transformers, accessories, etc., but required to make system operative to complete satisfaction of University's Representative, shall be provided at no increase in contract sum.

1. Refer to Division-26 sections for power wiring to line-voltage devices and for low voltage wiring and communication wiring to such applicable devices.
2. Refer to other Division-23 sections for controls necessary for temperature control systems.
3. The BACS scope of work shall include monitoring of other systems and equipment where indicated in the contract documents.

1.3 QUALITY ASSURANCE:

A. Electrical Standards: Provide electrical products which have been tested, listed, and labeled by Underwriters Laboratories (U.L.) and comply with NEMA standards.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's specifications for each control device furnished, including installation instructions and start-up instructions. Submit integrated wiring and electrical diagram to show complete system operation.

B. All submittals must be received and approved by the University prior to the ordering and installation of any equipment by the Contractor.

1. Provide the University with two separate Building Controls submittals. The first will occur 60 days after the contract award and the second at 90 days. The first will provide specific information concerning the actual control system hardware, the system architecture, the points log, and the peripherals that will be provided. The second submittal will include specific information illustrating the complete system wiring schematic, full color illustrations of any screen graphic to be used, detail of the software design, and a testing plan for system performance verification that is point by point. The detail of submittal requirements are described in more specifics by the design documents.
C. Maintenance Data: Submit maintenance data and spare parts lists for each type of control device. Include this data in the Operation and Maintenance manual.

1. Submit three (3) copies of completed volumes in draft form a minimum of 180 calendar days prior to substantial completion. One (1) Copy will be returned with University Representative’s comments. Revise content of documents as required prior to final submittal. No later than 60 days prior to substantial completion, the final submission of 2 copies of the O & M’s will be due. Submit O & M’s both in an electronic form (2 copies) and in hard paper form (2 copies). Compile the electronic copies entirely in Abode Acrobat complete with an interactive field linked Table of Contents (linked to the chapters and subsections within the report). Submit electronic copies on a CD (or CD’s).

1.5 PANELS:

A. Submit shop drawings showing construction and mounting details for review prior to construction. In addition, submit the following for review prior to panel and/or system fabrication and installation:

1. Field wiring diagrams showing wiring external to panel.
2. Panel internal wiring diagrams also showing panel terminal connections for external wiring, properly coordinated and keyed to external wiring diagram.
3. Designation of all switches, pilot lights, etc. and layout of instruments, switches, and nameplates of panel.

1.6 JOB CONDITIONS:

A. Coordinate the Work of this SECTION with that of other SECTIONS to ensure that the Work will be carried out in an orderly fashion. It shall be Contractor's responsibility to check the Contract Documents for possible conflicts between temperature control Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

1.7 INSTALLING CONTRACTOR QUALIFICATIONS:

A. The Building Automation System Control System contractor must have been in business, and licensed as a contractor by the State of California, installing HVAC and building automation controls, and fire/life safety systems, for a minimum of ten (10) years preceding the bid opening.

B. The Building Automation Control System contractor must have completed no less than one (1) control system installation, within twenty-four (24) months preceding the bid opening, pursuant to a single written contract, valued at no less than three hundred thousand ($300,000) dollars.

C. Within twenty-four (24) months preceding the bid opening, from the Building Automation Control System contractor's local office that will service the UC Davis Medical Center campus, the Building Automation Control System contractor must have completed at least twelve (12) projects, each of which included the installation of not less than five hundred (500) hardware input/output (I/O) points of the manufacturer type identified in subsection 2.01, A., under PART 2 – PRODUCTS, of this section. At least two (2) of these projects must have included the installation of not less than one thousand (1,000) hardware input/output (I/O) points of the manufacturer type identified in subsection 2.01, A., under PART 2 – PRODUCTS, of this section.
D. The Building Automation Control System contractor must demonstrate that, from the local office that will service the UC Davis Medical Center campus, a one (1) hour emergency response requirement can logistically be provided. The bidder must, in the judgment of the University's Representative, be able to generally provide one (1) hour emergency response. That is, to have appropriately equipped and trained personnel on-site within one (1) hour to rectify any potential emergency situation.

E. The Building Automation Control System contractor must have been, for five (5) years preceding the bid opening, a factory branch office, or a factory authorized dealer for the product manufacturer type identified in subsection 2.01, A., under PART 2 – PRODUCTS, of this section. Factory authorized dealer means:

1. Installing Contractor has a contract directly with the factory. A contract with a distributor is not acceptable.
2. Installing Contractor has direct access to factory technical support and training.

F. The Building Automation Control System contractor must have in its employ, at the local office that will service the U.C. Davis Medical Center campus, at least one (1) full time mechanical, or electrical engineer, registered as such by the State of California, having not less than three (3) years experience with the product manufacturer type identified in subsection 2.01, A., under PART 2 – PRODUCTS, of this section.

G. The Building Automation Control System contractor must have in its employ, at the local office that will service the U.C. Davis Medical Center campus, at least one (1) full time applications engineer, having not less than five (5) years experience with the manufacturer type identified in subsection 2.01, A., under PART 2 – PRODUCTS, of this section. The applications engineer and the aforementioned registered mechanical or electrical engineer may be the same person.

H. The Building Automation Control System contractor must have in its employ, at the local office that will service the U.C. Davis Medical Center campus, at least five (5) full time control technicians. At a minimum, one (1) technician must be senior (at least 5 years experience installing products of the manufacturer type identified in subsection 2.01, A., under PART 2 – PRODUCTS, of this section); two (2) technicians must be mid-level (at least three (3) years experience installing products of the manufacturer type identified in subsection 2.01, A., under PART 2 – PRODUCTS, of this section); and two (2) can be junior level technicians (at least one (1) year experience installing products of the manufacturer type identified in subsection 2.01, A., under PART 2 – PRODUCTS, of this section).

PART 2 - PRODUCTS

2.1 GENERAL:

A. Manufacturer: The Building Automation Control System shall be provided by the following:

1. Johnson Controls, Inc., to match campus standard.

B. All components used shall be serviceable, repairable, and replaceable by qualified temperature control technicians using non-proprietary parts, tools, and instruments.
2.2 TEMPERATURE CONTROL MATERIAL:

A. Electric Damper Actuators shall be spring return electric actuators that operate on 24 VAC or VDC power. Actuators shall be available for use with on/off, floating, proportional, or resistive controllers. The actuators may be direct or remote mounted to a damper, or mounted to a valve using a linkage kit. Actuators shall be properly sized to provide sufficient torque to position the damper through out its operating range. Actuators shall be provided and installed for equipment provided with dampers such as Air Handling Units in addition to dampers supplied and installed under this section of the specification.

B. Motorized Control Dampers: Shall be parallel blade for two-position control and opposed blade for proportional control applications. Dampers shall be black enamel finish or galvanized, with nylon bearings. Blade edge and tip seals shall be included for all dampers. Blade shall be double piece 22 gauge minimum and 8” wide maximum and frame shall be welded channel iron. Dampers with both dimensions under 18” may have strap iron frames.

C. Control Valves:
   1. Control valves shall be two-way pattern as shown, constructed for tight shut-off and shall operate against system pressures and differentials. Valves with sizes up to and including 2” shall be "screwed", 2-1/2” and larger valves shall be "flanged" configuration. Control valves shall be sized for a maximum pressure drop of 4.0 psig at rated flow (except as otherwise noted).
   2. Control valves for reheat coils and chilled water fan coils shall be pressure independent type, with a minimum rangeability of 100:1.
   3. Control valves for air handling units, heating hot water, main chilled water, domestic hot water and heat recovery systems shall be pressure independent modulating type.

D. Furnish temperature control panels (TCP) of NEMA code gauge steel with locking doors for mounting all devices as shown. They shall meet all applicable requirements of Title 24, California Code of Regulations. All controllers, relays, switches, etc. for equipment located in mechanical equipment rooms shall be mounted in aTCP as shown on the drawings. Temperature settings, adjustments and calibration shall be done at the TCP. Any required UCMC Campus Data networks connection for this panel shall be installed inside the panel. All electric devices within a control panel shall be factory pre-piped and wired. Provide engraved laminated plastic nameplates identifying all devices mounted on the face of the control panels. A complete set of related "as-builts" control drawings shall be furnished in each control panel.

E. Space (room) temperature sensors shall be non-occupant adjustable unless otherwise specified. Space temperature set points shall be operator adjustable through the control system operator workstation (OWS) and through operator interface devices connected to DDC network control panels.

F. Occupant temporary override switches will not be provided unless otherwise specified.

2.3 GENERAL PRODUCT DESCRIPTION:

A. The Building Automation Control System shall be capable of integrating multiple building functions including equipment supervision and control, alarm management, energy management, and historical data collection and archiving. The system shall include: Lighting control points utilizing the Division 26 lighting control system tied to Metasys via N2.

B. The Building Automation Control System shall consist of the following:
1. Standalone DDC panels
2. Standalone application specific controllers (ASCs)

C. System architectural design eliminates dependence upon any single device for alarm reporting and control execution. Each DDC panel shall operate independently by performing its own specified control, alarm management, operator I/O, and historical data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

D. Standalone DDC panels shall be able to access any date from, or send control commands and alarm reports directly to any other DDC panel or combination of panels on the network without dependence upon a central processing device. Standalone DDC panels shall also be able to send alarm reports to multiple operator workstations without dependence upon a central processing device.

2.4 STANDALONE DDC PANELS:

A. General: Standalone DDC panels shall be microprocessor based, multi-tasking, multi-user, and real-time digital control processors. Each standalone DDC panel shall consist of modular hardware with plug-in enclosed processors, communication controllers, power supplies, and input/output modules. A sufficient number of controllers shall be supplied to fully meet the requirements of this specification and the attached Appendix A Medical Equipment Input/Output Schedule.

B. Memory: Each DDC panel shall have sufficient memory to support its own operating system and databases including:

1. Control processes
2. Energy Management Applications
3. Alarm Management
4. Historical/Trend Data for all points
5. Maintenance Support Applications
6. Custom Processes
7. Operator I/O
8. Dial-Up Communications
9. Manual Override Monitoring

C. Point types: Each DDC panel shall support the following types of point inputs and outputs:

1. Digital Inputs for status/alarm contacts
2. Digital Outputs for on/off equipment control
3. Analog Inputs for temperature, pressure, humidity, water and air flow, and position measurements
   a. Analog Outputs for valve and damper position control, and capacity control of primary equipment.
   b. Pulse Inputs for pulsed contact monitoring
D. Expandability: The system shall be modular in nature, and shall permit easy expansion through the addition of software applications, workstation hardware, field controllers, sensors, and actuators.

1. The system architecture shall support 95% expansion capacity of all types of DDC panels, and all point types included in the initial installation.

E. Serial Communication Ports: Standalone DDC panels shall provide at least two (2) RS-232C serial data communication ports for simultaneous operation of multiple operator I/O devices such as industry standard printers, laptop workstations, PC workstations, and panel mounted or portable DDC panel Operator's Terminals. Standalone DDC panels shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers, or network terminals.

F. Hardware Override Switches: As indicated in the point schedule, the operator shall have the ability to manually override automatic or centrally executed commands at the DDC panel via local, point discrete, onboard hand/off/auto operator override switches for binary control points and gradual switches for analog control type points. These override switches shall be operable whether the panel is powered or not.

G. Hardware Override Monitoring: DDC panels shall monitor the status of position of all overrides, and include this information in logs and summaries to inform the operator that automatic control has been inhibited. DDC panels shall also collect override activity information for daily and monthly reports.

H. Local Status Indicator Lamps: The DDC panel shall provide local status indication for each binary input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.

I. Integrated On-Line Diagnostics: Each DDC panel shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all subsidiary equipment. The DDC panel shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each DDC panel, and shall not require the connection of an operator I/O device.

J. Surge and Transient Protection: Isolation shall be provided at all network terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standard 587-1980. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.

K. Powerfail Restart: In the event of the loss of normal power, there shall be an orderly shut down of all standalone DDC panels to prevent the loss of database or operating system software. Non-Volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours. Upon restoration of normal power, the DDC panel shall automatically resume full operation without manual intervention. Should DDC panel memory be lost for any reason, the user shall have the capability of reloading the DDC panel via the local area network, via the local RS-232C port, or via telephone line dial-in.

2.5 APPLICATION SPECIFIC CONTROLLERS - HVAC APPLICATIONS:

A. Each Standalone DDC Controller shall be able to extend its performance and capacity through the use of remote Application Specific Controllers (ASCs).
B. Each ASC shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.

C. Each ASC shall have sufficient memory to support its own operating system and data base including:
   1. Control Processes
   2. Energy Management Applications
   3. Operator I/O (Portable Service Terminal)

D. The operator interface to any ASC point data or programs shall be through any network-resident PC workstation, or any PC or portable operator's terminal connected to any DDC panel in the network.

E. Application Specific Controllers shall directly support the temporary use of a portable service terminal. The capabilities of the portable service terminal shall include but not be limited to the following:
   1. Display temperatures
   2. Display status
   3. Display setpoints
   4. Display control parameters
   5. Override binary output control
   6. Override analog setpoints
   7. Modification of gain and offset constants

F. Powerfail Protection: All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the controller.

G. Hardware Override Switches: As indicated in the point schedule, the operator shall have the ability to manually override automatic or centrally executed commands at the ASC panel via local, point discrete, onboard hand/off/auto operator override switches for binary control points and gradual switches for analog control type points. These override switches shall be operable whether the panel is powered or not.

H. Application Description:
   1. CAV Terminal Unit Controllers:
      a. CAV Terminal Unit Controllers shall support, but not be limited to, the control of the following configurations of CAV boxes to address current requirements as described in the Execution portion of this specification, and for future expansion:
         1) Single Duct Only (Cooling Only, or Cooling with Reheat)
         2) Fan Powered (Parallel/Side Pocket, Series/On-Off Logic)
         3) Dual Duct (Constant Volume, Variable Volume)
         4) Supply/Exhaust
b. CAV Terminal Unit Controllers shall support the following types of point inputs and outputs:

1) Proportional Cooling Outputs
2) Box and Baseboard Heating Outputs (Proportional, or 1 to 3 Stages)
3) Fan Control Output (On/Off Logic, or Proportional Series Fan Logic)

c. The modes of operation supported by the CAV Terminal Unit Controllers shall minimally include, but not be limited to, the following:

1) Day/Week Schedules
2) Comfort/Occupancy Mode
3) Economy Mode (Standby Mode, Unoccupied, etc.)
4) Temporary Override Mode

d. Occupancy-Based Standby/Comfort Mode Control: Each CAV Terminal Unit Controller shall have a provision for occupancy sensing overrides. Based upon the contact status of either a manual wall switch or an occupancy sensing device, the CAV Terminal Unit Controller shall automatically select either Standby or Comfort mode to minimize the heating and cooling requirements while satisfying comfort conditions.

e. Continuous Zone Temperature Histories: Each CAV Terminal Unit Controller shall automatically and continuously maintain a history of the associated zone temperature to allow users to quickly analyze space comfort and equipment performance for the past 24 hours. A minimum of two samples per hour shall be stored.

f. Alarm Management: Each CAV Terminal Unit Controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.

2. AHU Controllers

a. AHU Controllers shall support, but not be limited to, the following configurations of systems to address current requirements as described in the Execution portion of this specification, and for future expansion:

1) Large Air Handling Units (4000 CFM or more)
   a) Mixed Air-Single Path
   b) Mixed Air-Dual Path
   c) 100% Single Path
   d) 100% Dual Path

b. AHU Controllers shall support all the necessary point inputs and outputs to perform the specified control sequences in a totally standalone fashion.

c. AHU controllers shall have a library of control routines and program logic to perform the sequence of operation as specified in the Execution portion of this specification.

d. Occupancy-Based Standby/Comfort Mode Control: Each AHU Controller shall have a provision for occupancy sensing overrides. Based upon the contact status of either a manual wall switch or an occupancy sensing device, the AHU Controller shall automatically select either Standby or Comfort mode to minimize the heating and cooling requirements while satisfying comfort conditions.
e. Continuous Zone Temperature Histories: Each AHU Controller shall automatically and continuously, maintain a history of the associated zone temperature to allow users to quickly analyze space comfort and equipment performance for the past 24 hours. A minimum of two samples per hour shall be stored.

f. Alarm Management: Each AHU Controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.

PART 3 - EXECUTION

3.1 GENERAL:

A. Furnish all labor, materials, equipment, and service necessary for a complete and operating Direct Digital Control Building Automation Control System, as shown on the drawings and described herein.

B. All labor, material, equipment, and software necessary to meet the functional intent of the Building Automation Control System as specified herein and as shown on the drawings shall be included.

C. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein, or on the plans, that are required to meet the functional intent of the Building Automation Control System, shall be provided without additional cost to the University.

D. Equipment furnished by Electrical and/or Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Wiring normally performed in field shall be furnished and installed by the Building Automation Control System contractor.

E. Control equipment having electrical connections only, which are furnished under this work, shall be installed and connected by the Building Automation Control System contractor. Electrical devices requiring wet side piping connections shall be installed by the Mechanical Contractor.

F. Clearly identify and label equipment and controls, such as starters, switches, relays, as to function and position with permanently engraved plastic nameplates.

G. Wiring of control equipment in accordance with wiring diagrams and functional operation of the control system shall be the responsibility of the Building Automation Control System contractor.

H. Final Adjustment of Equipment: After completion of installation, adjust temperature sensors, control valves, actuators, motors, and similar equipment provided under the scope of work of this section. Cooperate with the air balance contractor as required.

I. Perform final adjustment by specially trained personnel in direct employ by the manufacturer of the primary Building Automation Control System.

J. Connect control valves with threaded connections with sufficient unions to permit valves to be readily removed from their installed locations for servicing, without disturbing adjacent piping. In no case shall this be less than three unions for three-way valves and one union for two-way valves.
K. Wiring and raceways in the BACS scope of works includes but is not limited to the following:

1. Power wiring for all controllers, sensors, relays and other equipment shall be taken from the local HVAC controls panels except equipment provided with dedicated supplies provided by Division 26.
2. Controls wiring shall be routed from the local HVAC controls panels.
3. Conduit shall be used for the following:
   a. All power wiring.
   b. All exposed and concealed low voltage wiring in all areas below 8 feet above floor level.
   c. All mechanical and equipment rooms, exterior locations and any other areas where physical protection and/or access is required as defined elsewhere in the contract documents.
   d. All in-wall drops to equipment monitoring and/or control points including but not limited to medical equipment, kitchen service equipment, elevator sump and other moisture sensors, water flow meters, equipment mounted alarms, etc.
   e. All areas where specifically indicated on the Drawings.
4. J-Hooks and or designated low voltage raceway shall be used for the following:
   a. All low voltage wiring above 8 feet above floor level in open and accessible areas where conduit is not required, to cable trays or other conduits.
   b. All areas where specifically indicated on the Drawings.
5. Conduit, wiring, J-Hook materials and installation requirements shall comply with the applicable sections of Division 26 unless specifically indicated otherwise on the Drawings.

3.2 WARRANTY:

A. The Building Automation Control System contractor shall provide a one-year warranty covering the Building Automation Control System, and all associated components installed by the Building Automation Control System contractor. Any manufacturing or installation defects arising during this warranty period shall be corrected without cost to the University. The Building Automation Control System contractor shall respond to the job site within a one (1) hour period for any emergency relating to the control system and associated components installed by the Building Automation Control System contractor. Warranty period shall commence after all operator instruction is completed and the entire system has been accepted by University.

3.3 CARE AND CLEANING:

A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to University's Representative. At completion, carefully clean and adjust equipment, fixtures, and trim installed as part of this work. Leave systems and equipment in satisfactory operating condition.
3.4 OPERATION TEST/SYSTEM COMMISSIONING:

A. Each piece of equipment shall be tested by the Building Automation Control System contractor to show that it will operate in accordance with designed requirements, and provide written documentation of this test. Control system commissioning shall consist of a point per point conformation and system operational demonstration conducted jointly by the Building Automation Control System contractor and the University’s Representative.

B. The mechanical contractor and BACS contractor/vendor will conduct two levels of Quality Assurance to verify that the required installation and performance of the Building Automation Control System as been met.

1. Static Commissioning:
   a. A point to point examination and documentation of the successful installation of the BACS system and its components in its entirety.
   b. The start up of all HVAC equipment and associated systems will not commence until this work has been completed and the documentation received by the University.

2. Dynamic Commissioning:
   a. A point by point demonstration and documentation of the successful performance of the BACS system and its components in its entirety.
   b. The verification demonstrations of all HVAC equipment and associated systems will not commence until this work has been completed and the documentation received by the University.

C. In General the Commissioning process will comprise the following:

1. Review of points list and documentation.
2. Installation compliance with project plans and specifications.
3. Point-to-point check.
4. Control devices calibration and operation.
5. System programming and documentation.
7. Control loop trends.
8. Reports and alarms.
9. Analog input calibration.
10. Analog output check and spring ranges.
11. Digital input range set points.
12. Digital output in autolog.
13. Point by point performance verification.
14. O & M training and documentation.
15. Opposite season verification and documentation.
3.5 OPERATOR INSTRUCTION:

A. During system commissioning and at such time acceptable performance of the Building Automation Control System hardware and software has been established, the Control Contractor shall schedule with the University’s Representative and provide forty (40) hours of on site, or off site, operator instruction to the University's operating personnel. Operator instruction during normal working hours shall be performed by a competent representative familiar with the systems hardware, software, and accessories.

END OF SECTION 230900
SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
      1. Hot-water heating piping.
      2. Chilled-water piping.
      3. Dual-temperature heating and cooling water piping.
   B. Related Sections include the following:
      1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
      2. Division 23 Section "HVAC Piping and Insulation".
      3. Division 23 Section "Expansion Fittings and Loops for HVAC Piping".

1.3 DEFINITIONS
   A. PTFE: Polytetrafluoroethylene.
   B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
   C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS
   A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
      1. Hot-Water Heating Piping: 150 psig at 240 degF.
      2. Chilled-Water Piping: 125 psig at 50 degF.
      3. Dual-Temperature Heating and Cooling Water Piping: 125 psig at 180 degF.
      4. Air-Vent Piping: 180 degF.
1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Steel, copper, and galvanized pipe and fittings.
   2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
   3. Air control devices.
   4. Hydronic specialties.

B. Shop Drawings: Detail, at ¼ scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

C. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.9 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME
Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B88 Type L.
B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
C. Wrought-Copper Fittings: ASME B16.22.
D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.
F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   2. End Connections: Butt welding.
   3. Facings: Raised face.
H. Grooved Mechanical-Joint Fittings and Couplings:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Victaulic Company
      b. Anvil International, Inc.
      c. Or equal.
2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inchimum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Wilkins; a Zurn company.
   c. Matco-Norca, Inc.
   e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   f. Or equal.
2. Description:

C. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Wilkins; a Zurn company.
      b. Matco-Norca, Inc.
      c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      d. Or equal.

2. Description:
   b. Factory-fabricated, bolted, companion-flange assembly.
   c. Pressure Rating: 150 psig.
   d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.5 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Bell & Gossett Domestic Pump; a division of ITT Industries.
      b. Armstrong Pumps, Inc.
      c. Griswold Controls.
      d. Taco.
      e. Or equal.

   2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
   3. Ball: Brass or stainless steel.
   4. Plug: Resin.
   5. Seat: PTFE.
   6. End Connections: Threaded or socket.
   8. Handle Style: Lever, with memory stop to retain set position.
   9. CWP Rating: Minimum 125 psig
   10. Maximum Operating Temperature: 250 deg F
2.6 AIR CONTROL DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bell & Gossett Domestic Pump; a division of ITT Industries.
2. Wessels Company
3. Amtrol, Inc.
4. Taco.
5. Or equal.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2
5. Discharge Connection: NPS 1/8
6. CWP Rating: 150 psig
7. Maximum Operating Temperature: 225 deg F

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
4. Inlet Connection: NPS 1/2
5. Discharge Connection: NPS 1/4
6. CWP Rating: 150 psig
7. Maximum Operating Temperature: 240 deg F

D. Diaphragm Type Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Diaphragm: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.

E. Tangential-Type Air Separators:

1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
5. Size: Match system flow capacity.

F. In-Line Air Separators:
1. **Tank**: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. **Maximum Working Pressure**: Up to 175 psig
3. **Maximum Operating Temperature**: Up to 300 deg F

**G. Air Purgers:**

1. **Body**: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
2. **Maximum Working Pressure**: 150 psig
3. **Maximum Operating Temperature**: 250 deg F

### 2.7 CHEMICAL TREATMENT

**A.** All work to be confirmed with the University Representative.

**B.** Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.

1. **Chemicals**: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

**C.** Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

### 2.8 HYDRONIC PIPING SPECIALTIES

**A.** Y-Pattern Strainers:

1. **Body**: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. **End Connections**: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. **Strainer Screen**: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. **CWP Rating**: 125 psig

**B.** Basket Strainers:

1. **Body**: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. **End Connections**: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. **Strainer Screen**: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. **CWP Rating**: 125 psig

**C.** T-Pattern Strainers:

1. **Body**: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. **End Connections**: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig

D. Stainless-Steel Bellow, Flexible Connectors:
2. End Connections: Threaded or flanged to match equipment connected.
4. CWP Rating: 150 psig
5. Maximum Operating Temperature: 250 deg F

E. Spherical, Rubber, Flexible Connectors:
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
4. CWP Rating: 150 psig
5. Maximum Operating Temperature: 250 deg F

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 smaller, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe; Class 150 malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Hot-water heating piping installed belowground and within slabs shall be the following:
1. Type K annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.

D. Chilled-water piping, aboveground, NPS 2 and smaller, shall be the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

E. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

F. Dual-temperature heating and cooling water piping, aboveground, NPS 2 and smaller, shall be the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
   2. Schedule 40 steel pipe; 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

G. Dual-temperature heating and cooling water piping, aboveground, NPS 2-1/2 and larger, shall be the following:
   1. Type L drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
   2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
   3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

H. Air-Vent Piping:
   1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
   2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
B. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
C. Install check valves at each pump discharge and elsewhere as required to control flow direction.
D. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
E. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install 1” weldolet at each main shut off valve, 2-1/2” and larger. Install full port ball valve and plug for future pressure testing, flow measurement, and purging.

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 groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

M. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

N. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

O. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

T. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

U. Install low point drains on all piping at the lowest point in the system to enable the total drain down of the system for the purpose of repairs, retrofits or remodels. Lines from 4” through 10” pipe shall have a 2” low point drain and 2” SOV. Lines 2” through 3-1/2” shall be a 1-1/8” low point drains and 1-1/2” SOV. Smaller size lines use line size low point drains and SOV’s. Include plugs in end of shutoff valves. Locate bleeder and drain valves to within 6” of the accessible ceiling. Drain valves shall be 800 lb. Full port gate valve on 240º heating hot water systems.
V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
F. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

G. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.


E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.


G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

F. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

G. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
   1. Install tank fittings that are shipped loose.
   2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

H. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
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1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.

3. Isolate expansion tanks and determine that hydronic system is full of water.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing.

7. Refer to Section 01 86 00 Plumbing/HVAC Testing Procedures.

C. Perform the following before operating the system:

1. Open manual valves fully.

2. Inspect pumps for proper rotation.

3. Set makeup pressure-reducing valves for required system pressure.

4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

5. Set temperature controls so all coils are calling for full flow.

6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.

7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13
SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Sealants and gaskets.
2. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

1.5 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   
   a. **Spiral Manufacturing Co., Inc.**
   b. McGill AirFlow LLC.
   c. SEMCO Incorporated.
   d. Sheet Metal Connectors, Inc.
   e. Or equal.

2. **Transverse Joints:** Select joint types and fabricate according to SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible."
   
   1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

3. **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."
   
   1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
   2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

4. **Tees and Laterals:** Select types and fabricate according to SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible."

### 2.3 **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/A 653M.
   

C. **Carbon-Steel Sheets:** Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
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 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Sealant shall comply with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”
11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
12. Service: Indoor or outdoor.
13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

2. Type: S.
3. Grade: NS.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.
2.6 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Mason Industries.
   2. Ductmate Industries, Inc.
   3. Hilti Corp.
   5. TOLCO; a brand of NIBCO INC.
   6. Unistrut Corporation; Tyco International, Ltd.
   7. Or equal.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by the Office of Statewide Health Planning and Development for the State of California.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

3.2 DUCT SEALING

A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.3 HANGER AND SUPPORT INSTALLATION

A. All work to comply with Section 01 45 10 and Section 23 05 29.

B. Building Attachments: Concrete inserts (Hilti KB-TZ), powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections. Comply with requirements of Sections 01 45 00, 01 45 23, and 01 86 00.

3.6 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.7 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Constant-Volume Air-Handling Units:
   a. Pressure Class: Positive 3-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 12.
2. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive 3-inch wg.
   b. Minimum SMACNA Seal Class: A

C. Return Ducts:
   1. Ducts Connected to Air-Handling Units:
      a. Pressure Class: Positive or negative 2-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 6.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

D. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 3-inch wg.
      b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
      c. SMACNA Leakage Class for Rectangular: 24.
      d. SMACNA Leakage Class for Round and Flat Oval: 24.

E. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
      a. Velocity 1000 fpm or Lower:
         1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
         2) Mitered Type RE 4 without vanes.
      b. Velocity 1000 to 1500 fpm:
         1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
         2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
         3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
      c. Velocity 1500 fpm or Higher:
         1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
         2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to-Diameter Ratio: 1.5.
   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

F. Branch Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
      a. Rectangular Main to Rectangular Branch: 45-degree entry.
      b. Rectangular Main to Round Branch: Spin in.
   2. Round and Flat Oval: 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 1000 fpm or Lower: 90-degree tap.
      b. Velocity 1000 to 1500 fpm: Conical tap.
      c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113
SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   2. Control dampers.
   3. Combination fire and smoke dampers.
   4. Flexible ducts.
   5. Inline filter assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

B. Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   2. Exposed-Surface Finish: Mill phosphatized.

B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Ruskin Company.
      b. Pottorff.
      c. McGill AirFlow LLC.
      d. Vent Products Company, Inc.
      e. Or equal.
   2. Standard leakage rating, with linkage outside airstream.
   3. Suitable for horizontal or vertical applications.
   4. Frames:
      a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
      b. Mitered and welded corners.
      c. Flanges for attaching to walls and flangeless frames for installing in ducts.
   5. Blades:
      a. Multiple or single blade.
      b. Parallel- or opposed-blade design.
      c. Stiffen damper blades for stability.
      d. Galvanized-steel, 0.064 inch thick.
   7. Bearings:
      a. Oil-impregnated bronze.
      b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
2.4 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Ruskin Company.
   2. Greenheck Fan Corporation.
   3. Pottorff.
   4. Or equal.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded interlocking, gusseted corners and mounting flange.

F. Heat-Responsive Device: Replaceable, 212 deg F rated, fusible links.

G. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.

H. Smoke Detector: Integral, factory wired for single-point connection.

I. Blades: Roll-formed, horizontal, interlocking, 0.034 inch thick, galvanized sheet steel.

J. Leakage: Class II.

K. Rated pressure and velocity to exceed design airflow conditions.

L. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application.

M. Accessories:
   1. Auxiliary switches for position indication.
   2. Test and reset switches, remote mounted.

2.5 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Ductmate Industries, Inc.
   2. Elgen Manufacturing.
   3. Flexmaster U.S.A., Inc.
   5. McGill AirFlow LLC.
   6. Pottorff.
   7. Ventfabrics, Inc.

1. Door:
   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
   d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.6 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
4. Or equal.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.

2.7 Inline Filter Assembly

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Camfil Farr Co.
2. AAF International
3. Or equal.
B. Housing: Constructed of all-welded 14-gauge galvanized steel and reinforced with channel braces.

C. Access: Dual access doors mounted on pin-hinges. Incorporate swing bolt fastening with clamps to provide uniform filter sealing.

D. Filter Efficiency: As scheduled on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install fire and smoke dampers according to UL listing.

G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Control devices requiring inspection.
9. Elsewhere as indicated.
H. Install access doors with swing against duct static pressure.

I. Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.

J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

M. Install duct test holes where required for testing and balancing purposes.

N. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Comply with requirements of Sections 01 45 00, 01 45 23, and 01 86 00.
   2. Operate dampers to verify full range of movement.
   3. Inspect locations of access doors and verify that purpose of access door can be performed.
   4. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
   5. Inspect turning vanes for proper and secure installation.
   6. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300
SECTION 233416 - CENTRIFUGAL HVAC FANS

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: For each product.

1. Backward-inclined centrifugal fans.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Include rated capacities, furnished specialties, and accessories for each fan.
2. Certified fan performance curves with system operating conditions indicated.
3. Certified fan sound-power ratings.
4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
5. Dampers, including housings, linkages, and operators.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AMCA Compliance:

1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.
2. Operating Limits: Classify according to AMCA 99.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Capacities and Characteristics:
   1. Total Airflow: As scheduled on the drawings.
   2. External Static Pressure: As scheduled on the drawings.
   3. Class: I. 
   4. Arrangement: Inline 
   5. Housing Material: Galvanized steel.
   7. Drive Type: Belt.
   8. Motor:
      b. Motor Type: Varigreen EC type, 1-10 VDC input
      c. Efficiency: Premium efficient.
      d. NEMA Design: 1
      e. Electrical Accessories: Transformer, mounted and wired, UL/CUL 705 listed.

2.2 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
   1. Greenheck.
   2. Loren Cook.
   3. Aerovent; a Twin City Fan company.
   5. Or equal.

B. Description:
   1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
   2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
   3. Factory-installed and -wired disconnect switch.

C. Housings:
   1. Formed panels to make curved-scroll housings with shaped cutoff.
   2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
   3. Horizontally split, bolted-flange housing.
   4. Spun inlet cone with flange.
   5. Outlet flange.
D. Backward-Inclined Wheels:
   1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades, and fastened to shaft with set screws.
   2. Welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.

E. Shafts:
   1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
   2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
   3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Prelubricated and Sealed Shaft Bearings:
   1. Self-aligning, pillow-block-type ball bearings. L10 in excess of 100,000 hours.

G. Belt Drives:
   1. Factory mounted, with adjustable alignment and belt tensioning.
   2. Service Factor Based on Fan Motor Size: 1.5.
   3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
   4. Motor Pulleys: Adjustable pitch for use with motors through 5 HP.
   5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
   6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

H. Accessories:
   2. Companion Flanges: Rolled flanges for duct connections of same material as housing.

2.3 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install centrifugal fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Install units with clearances for service and maintenance.

E. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Verify lubrication for bearings and other moving parts.
7. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
8. See Division 23 Section "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
9. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.
END OF SECTION 233416
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. Rectangular and square ceiling diffusers.
   2. Fixed face grilles.

B. Related Sections:
   1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Titus.
   b. Krueger.
   c. Price Industries.
   d. Or equal.

2. Devices shall be specifically designed for variable-air-volume flows.
4. Finish: Baked enamel, white.

B. Modular Core Supply Grilles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Titus.
   b. Krueger.
   c. Price Industries.
   d. Or equal.

2. Throw: Extended distance for airflow rates.
4. Cores per Unit: Four.
7. Blades:
   a. Airfoil, individually adjustable horizontally.
   b. Set in modules.

8. Modules: Removable; rotatable.
9. Mounting: Surface or layin.

C. Fixed Face Register:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Titus.
   b. Krueger.
   c. Price Industries.
   d. Or equal.
3. Finish: Baked enamel, white.
5. Frame: 1-1/4 inches (32 mm) wide.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713
SECTION 235700 - HEAT EXCHANGERS FOR HVAC

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes plate heat exchangers.

1.3 DEFINITIONS
   A. TEMA: Tubular Exchanger Manufacturers Association.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
   B. Product Certificates: For each type of shell-and-tube heat exchanger. Documentation that shell-and-tube heat exchangers comply with "TEMA Standards."
   C. Source quality-control reports.
   D. Field quality-control reports.
   E. Sample Warranty: For manufacturer's warranty.

1.5 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.

1.6 WARRANTY
   A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of domestic-water heat exchangers that fail in materials or workmanship within specified warranty period.
      1. Failures include, but are not limited to, the following:
a. Structural failures including heat exchanger, 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. Plate, Type Heat Exchanger – 5 years

PART 2 - PRODUCTS

2.1 GASKETED-PLATE HEAT EXCHANGERS

A. Basis of Product Design: Subject to compliance with requirements, provide or comparable product by one of the following:

   1. ITT / Bell & Gossett
   2. Alfa Laval
   3. Tranter.
   4. Or equal.

B. Configuration: Freestanding assembly consisting of frame support, top and bottom carrying and guide bars, fixed and movable end plates, tie rods, individually removable plates, and one-piece gaskets.

C. Construction: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1.

D. Frame:

   1. Capacity to accommodate 20 percent additional plates.
   2. Painted carbon steel with provisions for anchoring to support.

E. Top and Bottom Carrying and Guide Bars: Painted carbon steel, aluminum, or stainless steel.

   1. Fabricate attachment of heat-exchanger carrying and guide bars with reinforcement strong enough to resist heat-exchanger movement during seismic event when heat-exchanger carrying and guide bars are anchored to building structure.

F. End-Plate Material: Painted carbon steel.

G. Tie Rods and Nuts: Steel or stainless steel.

H. Plate Material: Per drawings.

I. Gasket Materials: Per drawings.

J. Piping Connections: Factory fabricated of materials compatible with heat-exchanger shell. Attach tappings to shell before testing and labeling.

   1. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
   2. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
2.2 SOURCE QUALITY CONTROL


B. Hydrostatically test heat exchangers to minimum of one and one-half times pressure rating before shipment.

C. Heat exchangers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for compliance with requirements for installation tolerances and for structural rigidity, strength, anchors, and other conditions affecting performance of heat exchangers.

B. Examine roughing-in for heat-exchanger piping to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GASKETED-PLATE HEAT-EXCHANGER INSTALLATION

A. Install gasketed-plate heat exchanger on custom-designed wall supports anchored to structure as indicated on Drawings.

B. Install stainless steel shroud over installed gasketed-plate heat exchanger according to manufacturer's written instructions.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in other Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to heat exchangers to allow space for service and maintenance of heat exchangers. Arrange piping for easy removal of heat exchangers.

C. Install shutoff valves at heat-exchanger inlet and outlet connections.

D. Install relief valves on heat-exchanger heated-fluid connection and install pipe relief valves, full size of valve connection, to floor drain.

E. Install vacuum breaker at heat-exchanger steam inlet connection.

F. Install hose end valve to drain shell.
G. Install thermometer on heat-exchanger and inlet and outlet piping, and install thermometer on heating-fluid inlet and outlet piping. Comply with requirements for thermometers specified in Section 230519 "Meters and Gages for HVAC Piping."

H. Install pressure gages on heat-exchanger and heating-fluid piping. Comply with requirements for pressure gages specified in Section 230519 "Meters and Gages for HVAC Piping."

3.4 FIELD QUALITY CONTROL

A. *Comply with requirements of Sections 01 45 00, 01 45 23, 01 86 00.*

B. Perform the following tests and inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Heat exchanger will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 CLEANING

A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

**END OF SECTION 235700**
SECTION 237413 - CUSTOM OUTDOOR AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:

1. Custom Air Handling Units
2. Roof curbs.

1.3 DEFINITIONS

A. DDC: Direct-digital controls.
B. VVT: Variable-air volume and temperature.

1.4 PERFORMANCE REQUIREMENTS

A. Refer to Structural Drawings for design criteria

1.5 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each AHU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.


1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements."

B. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
1. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control test reports.

D. Warranty: Special warranty specified in this Section.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For AHUs to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of filters for each unit.

1.9 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for AHUs.
2. Comply with ARI 270 for testing and rating sound performance for AHUs.

B. ASHRAE Compliance:

1. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
2. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.10 WARRANTY

A. Warranty: Manufacturer's standard parts only warranty. 18 months from ship or 12 Months from startup whichever occurs first. Labor Warranty to be covered by Mechanical Contractor
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide custom outdoor air handling units as manufactured byproducts by one of the following:

1. Temtrol
2. Governaire
3. Huntair
4. Or equal

C. General Fabrication Requirements for Casings: The construction of the air handling unit shall consist of a (1” x 2”) steel frame with formed aluminum exterior casing panels. The exterior casing panels shall be attached to the gasketed (1 x 2) steel frame with corrosion resistant fasteners. All casing panels shall be completely removable from the unit exterior without affecting the unit’s structural integrity. (Units without framed type of construction shall be considered, provided the exterior casing panels are made from 14 gauge galvanized steel, maximum panel center lines are less than 20 inches and deflection is less than L/240 @ 9” positive pressure). The air handling unit casing shall be of the “no-through-metal” design. The casing shall incorporate insulating thermal breaks as required so that, when fully assembled, there’s no path of continuous unbroken metal to metal conduction from inner to outer surfaces. Provide necessary support to limit casing deflection to L/240 of the narrowest panel dimension. If panels cannot meet this deflection, additional internal reinforcing is required. All panel seams shall be caulked and sealed for an airtight unit. Leakage rates shall be less than 1% at design static pressure or 9” W.C. whichever is greater. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

D. External Casing - 16 GA Galvalized. Painted with a polyester resin coating designed for long term corrosion resistance meeting or exceeding (ASTM B-117) Salt Spray Resistance at 95 degrees F. 2,500 hrs. and (ASTM D-2247) Humidity Resistance at 95 degrees F. 2,500 hrs. The color shall be sandstone.

E. Internal Casing:

1. 20 GA Galvanized Steel Solid Liner.

F. Floor Construction:

1. 16 GA Galvanized Steel with 20 GA Galvanized Subfloor

G. Floor Drains – The unit shall be furnished with floor drains shall be installed as shown on drawings. The floor drains shall be large capacity with a protective cover. All floor drains shall be fully piped to the unit exterior with steel pipe.

H. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
2.2 PANELS

A. Entire unit to be insulated with a full 3” (R13) The insulation shall have an effective thermal conductivity (C) of .24 (BTU in./sq.ft. F°) and a noise reduction coefficient (NRC) of 0.70 / per inch thick (based on a type "A" mounting). The coefficients shall meet or exceed a 3.0 P.C.F. density material rating. Insulation shall meet the erosion requirements of UL 181 facing the air stream and fire hazard classification of 25/50 (per ASTM-84 and UL 723 and CAN/ULC S102-M88) and meet NFPA 90A and 90B. All insulation edges shall be encapsulated within the panel. All perforated sections shall have Micromat® or equal insulation with non-woven mat facing, 5000 fpm rating and non-hygroscopic fibers as manufactured by Johns Manville or approved equal.

2.3 DOORS

A. The unit shall be equipped with a solid double wall insulated hinged access doors as shown on the plans. The doorframe shall be extruded aluminum, foam filled with a built in thermal break barrier and full perimeter gasket. The door hinge assembly shall be completely adjustable die cast stainless steel. There shall be a minimum of two heavy duty handles per door. Provide ETL, UL 1995, and CAL-OSHA approved tool operated safety latch on all fan section access doors.

2.4 FANS

A. Supply / Return Fan Section – Provide multiple fan array system that includes multiple, direct driven, arrangement 4 plenum fans constructed per AMCA requirements for the duty specified class III as required. Class I fans are not acceptable. Fans shall be rated in accordance with and certified by AMCA for performance. All fans shall be selected to deliver the specified airflow quantity at the specified operating Total Static Pressure and specified fan/motor speed. The fan array shall be selected to operate at a system Total Static Pressure that does not exceed 90% of the specified fan’s peak static pressure producing capability at the specified fan/motor speed. Each fan/motor cube or cell shall include a minimum 10 gauge, G 90 Galvanized steel intake wall, .100 aluminum spun fan inlet funnel, and an 7 gauge G90 Galvanized steel motor support plate rail and structure. All motors shall be standard foot mounted type TEAO selected at the specified operating voltage, RPM, and efficiency as specified or as scheduled elsewhere. Motors shall meet the requirements of NEMA MG-1 Part 30 and 31, section 4.4.2. Motors shall be as manufactured by Baldor, Siemens, or Toshiba for use in multiple fan arrays that operate at varying synchronous speeds as driven by an approved VFD. Motor HP shall not exceed the scheduled HP as indicated in the AHU equipment schedule(s). Steel cased motors and/or ODP motors are not acceptable. All motors shall include permanently sealed (L10-400,000 hr) bearings and shaft grounding to protect the motor bearings from electrical discharge machining due to stray shaft currents. Each fan/motor assembly shall be dynamically balanced to meet AMCA standard 204-96, exceeding category BV-5, to meet or exceed an equivalent Grade G.55, producing a maximum rotational imbalance of .022” per second peak, filter in ( .55mm per second peak, filter in). Fan and motor assemblies submitted for approval incorporating larger than 22” wheel size and 215 T frames size motors shall be balanced in three orthogonal planes to demonstrate compliance with the G.55 requirement with a maximum rotational imbalance of .022” per second peak filter in ( .55 mm per second peak, filter in). Copies of the certified balancing reports shall be provided with the unit O&M manuals at the time of shipment. Submittals that do not include a statement of compliance with this requirement will be returned to the contractor without review. A smaller quantity of fans than scheduled is not acceptable. The supply fan sections shall include a coplanar attenuator.
B. Supply Fan and Return Fan Vertical Blade Backdraft Damper - Each individual cube or cell in the multiple fan arrays shall be provided with an integral back flow prevention device that prohibits recirculation of air in the event a fan or multiple fans become disabled. The system effects for the back flow prevention device(s) shall be included in the criteria for TSP determination for fan selection purposes, and shall be indicated as a separate line item SP loss in the submittals. Submitted AHU performance that does not indicate allowance for system effects for the back flow prevention device(s) and the system effect for the fan and motor enclosure in which each fan is mounted, will be returned to the contractor disapproved and will need to be resubmitted with all of the requested information included for approval. Back Draft Damper performance data that is per AMCA ducted inlet and discharge arrangements will not be accepted. Damper data must be for the specific purpose of preventing back flow in any disabled fan cube and that is mounted directly at the inlet of each fan. Motorized dampers for this purpose are not acceptable. Submitted fan performance data which only reflect published performance for individual fans in AMCA arrangement "A" free inlet and discharge will not be accepted. AHU Manufacturers that do not manufacture the fans being submitted on must provide certified performance data for fans as installed in the AHU unit with Back Draft damper effects included. At the sole discretion of the engineer, such performance testing may be witnessed by the engineer and/or the owner’s representative.

C. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.5 COILS

A. All coil assemblies shall be leak tested under water at 315 PSIG and PERFORMANCE is to be CERTIFIED under ARI Standard 410. Coils exceeding the range of ARI standard rating conditions shall be noted.

B. Chilled Water Coils

1. Cooling coils shall be mounted on stainless steel support rack to permit coils to slide out individually from the unit. Provide intermediate drain pans on all stacked cooling coils. The intermediate pan shall drain to the main drain pan through a copper downspout.
2. Water coils shall be constructed of seamless copper tubing mechanically expanded into fin collars. All fins shall be continuous within the coil casing to eliminate carryover inherent with a split fin design. Fins are die formed Plate type.
3. Headers are to be seamless copper with die formed tube holes.

C. Hot Water Coils

1. Heating coils shall be mounted on stainless steel support rack to permit coils to slide out individually from the unit.
2. Water coils shall be constructed of seamless copper tubing mechanically expanded into fin collars. Fins are die formed Plate type.
3. Headers are to be seamless copper with die formed tube holes.

2.6 DAMPERS

A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with motorized damper motor.
B. Outdoor- and Return-Air Mixing Dampers: Low leakage opposed blade dampers have stainless steel airfoil blades, stainless steel square shafting, heavy duty non corrosive nylon shaft bearings, santoprene rubber edge seals, UVC rated jamb seals, a 16 ga 304 Stainless steel frame and concealed stainless steel linkage.

1. Actuators are to be furnished and installed by Controls Contractor.

2.7 ELECTRICAL POWER CONNECTION

A. Refer to plan equipment schedule.

2.8 CONTROLS

A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC."

2.9 ROOF CURBS

A. Provide custom roof curbs capable of withstanding wind or seismic restraints specified in the Structural Drawings.

B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

   a. Materials: ASTM C 1071, Type I or II.
   b. Thickness: 2 inches.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

   a. Liner Adhesive: Comply with ASTM C 916, Type I.
   b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
   c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
   d. Liner Adhesive: Comply with ASTM C 916, Type I.

C. Curb Height: 14 inches.

D. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match AHU, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for wind-load requirements.
2.10  CAPACITIES AND CHARACTERISTICS

1. Refer to drawing mechanical equipment schedules

PART 3 - EXECUTION

3.1  EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of AHUs.

B. Examine roughing-in for AHUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where AHUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2  INSTALLATION

A. Equipment Mounting:

1. Install AHUs on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in the Structural drawings.

2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Roof Curb: Install on roof structure or concrete base, level and secure, according to drawing details. Install AHUs on curbs and coordinate penetrations and flashing with roof construction. Secure AHUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts – refer to Structural drawings.

C. Coordinate wall penetrations and flashing with wall construction.

3.3  CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Connect supply ducts to AHUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."

2. Install return-air duct continuously through roof structure.

3.4  FIELD QUALITY CONTROL
A. **Comply with requirements of Sections 01 45 00, 01 45 23, 01 86 00.**

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.
   
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

D. Tests and Inspections:
   
   1. After installing AHUs and after electrical circuitry has been energized, test units for compliance with requirements.
   2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Remove and replace malfunctioning units and retest as specified above.

### 3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
   
   1. Inspect for visible damage to unit casing.
   2. Inspect for visible damage to coils and fans.
   3. Inspect internal insulation.
   4. Verify that labels are clearly visible.
   5. Verify that clearances have been provided for servicing.
   6. Verify that controls are connected and operable.
   7. Verify that filters are installed.
   8. Remove packing from vibration isolators.
   9. Verify lubrication on fan and motor bearings.
   10. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
   11. Start unit according to manufacturer’s written instructions.
      
      a. Complete startup sheets and attach copy with Contractor's startup report.
   12. Inspect and record performance of interlocks and protective devices; verify sequences.
   13. Operate unit for an initial period as recommended or required by manufacturer.
   14. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
      
      a. Supply-air volume.
      b. Return-air volume.
      c. Relief-air volume.
      d. Outdoor-air intake volume.
e. Full design flow supply fan and return fan variable speed drive frequency (Hz).
f. Full design flow supply fan and return fan variable speed drive frequency (Hz) with one fan in failure mode, respectively.

15. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. After completing system installation and testing, adjusting, and balancing AHU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain AHUs – provide four hours of training.

END OF SECTION 237413
SECTION 238216 - HYDRONIC AIR COILS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes hydronic heating and cooling air coils.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS
A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 DESCRIPTION
A. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

2.2 COILS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Temtrol.
   3. USA Coil & Air.
   4. Or Equal.

B. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.
C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.
D. Source Quality Control: Factory tested to 300 psig.
E. Tubes: ASTM B 743 copper, minimum 0.035 inch thick.
F. Fins: Aluminum, minimum 0.010 inch thick.
G. Headers: Seamless copper tube with brazed joints, prime coated.
H. Frames: Galvanized-steel channel frame, minimum 0.064 inch thick for flanged mounting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install coils level and plumb.

B. Install coils in metal ducts and casings constructed according to SMACNA’s "HVAC Duct Construction Standards, Metal and Flexible."

C. Straighten bent fins on air coils.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to coils to allow service and maintenance.

C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Section 230923.11 "Control Valves," and other piping specialties are specified in Section 232116 "Hydronic Piping Specialties."

END OF SECTION 238216
SECTION 239999 - VARIABLE FREQUENCY DRIVES

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. Variable Frequency Drives.

B. Related Sections:

1. Division 26 for power wiring and general electrical requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Outline dimensions, conduit entry locations and weight.
2. Customer connection and power wiring diagrams.
3. Complete technical product description including list of options.
4. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).

   a. The VFD manufacturer shall provide calculations, specific to this installation, showing total harmonic voltage is less than 5%. All VFD’s shall include a minimum of 5% impedance reactors, no exceptions.

1.4 QUALITY ASSURANCE

A. Referenced Standards:

2. UL508C
3. ICS 7.0, AC Adjustable Speed Drives
4. IEC 16800 Parts 1, 2, and 3
5. NEC 430.120, Adjustable-Speed Drive Systems
6. IBC 2006 Seismic – referencing ASC 7-05 and ICC AC-156

B. Qualifications:

1. VFDs and options shall be UL listed as a complete assembly. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.
2. CE Mark – The VFD shall meet product standard EN 61800-3 for the First Environment restricted level. (RFI/EMI Filter spec).
PART 2 - PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB.
2. Danfoss.
3. Or equal.

B. UL Listed Enclosure: The VFD package as specified shall be enclosed in a UL Listed Type enclosure; enclosures with only NEMA ratings are not acceptable.

1. Environmental operating conditions: 32 to 104°F (0 to 40° C) continuous. Altitude 0 to 3,300 feet above sea level, less than 95% humidity, non-condensing. All circuit boards shall have conformal coating.
2. Enclosures shall be UL rated and shall be UL listed as a plenum rated VFD.

C. Standard Features: All VFDs shall have the following features:

1. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
2. The keypad shall include Hand-Off-Auto selections and manual speed control. There shall be fault reset and “Help” buttons on the keypad. The “Help” button shall include “on-line” assistance for programming and troubleshooting.
3. The VFD shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection from AC line transients.
4. The input current rating of the VFD shall be no more than 3% greater than the output current rating.
5. The VFD shall provide a programmable loss-of-load (broken belt / broken coupling) Form-C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and/or over the serial communications bus.

D. Adjustments: All VFDs to have the following adjustments:

1. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad command, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. A minimum of two separate safety interlock inputs shall be provided. When any safety is opened, the motor shall be commanded to coast to stop and the damper shall be commanded to close.
2. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates.
3. The VFD shall include a fireman’s override input. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlocks, and force the motor to run at a preset speed or in a separate PID mode.

E. Serial Communications: The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet MS/TP. The use of third party gateways and multiplexers is not acceptable. All protocols shall be “certified” by the governing authority (i.e. BTL Listing for BACnet).

F. EMI / RFI Filters: All VFD’s shall include EMI/RFI filters. The onboard filters shall allow the entire VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted. No Exceptions.

G. Optional Features: Optional features to be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.

H. Bypass Controller:

1. A complete factory wired and tested bypass system consisting of a door interlocked, padlockable circuit breaker, output contactor, bypass contactor, and fast acting VFD isolation fuses.
2. The bypass enclosure door and VFD enclosure must be mechanically interlocked such that the disconnecting device must be in the “Off” position before either enclosure may be accessed.
3. The VFD and bypass package shall have a UL listed short circuit current rating (SCCR) of 100,000 amps and this rating shall be indicated on the UL data label.
4. The drive and bypass package shall be seismic certified and labeled to the IBC:
   a. Seismic importance factor of 1.5 rating is required, and shall be based upon the actual shake test data as defined by ICC AC-156.
5. Drive Isolation Fuses - To ensure maximum possible bypass operation, fast acting fuses, exclusive to the VFD, shall be provided to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection. This maintains bypass operation capability in the event of a VFD failure. Bypass designs, which have no such fuses, will not be accepted.
6. The system (VFD and Bypass) tolerated voltage window shall allow the system to operate from a line of +30%, -35% nominal voltage range. The system shall incorporate circuitry that will allow the drive or bypass contactor to remain “sealed in” over this voltage tolerance at a minimum.
7. The bypass shall maintain positive contactor control throughout the voltage tolerance window of nominal voltage +30%, -35%. This feature is designed to avoid contactor coil failure during brown out / low line conditions and allow for input single phase operation when in the VFD mode. Designs that will not allow input single phase operation in the VFD mode are not acceptable.
8. Motor protection from single phase power conditions - the bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in bypass mode are not acceptable.
9. The bypass system shall NOT depend on the VFD for bypass operation. The bypass system shall be designed for standalone operation and shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the system for repair / replacement. Serial communications shall remain functional even with the VFD removed.

10. Serial communications – the bypass shall be capable of being monitored and / or controlled via serial communications. On-board communications protocols shall include ModBus, Johnson Controls N2, Siemens Building Technologies FLN (P1), and BACnet MS/TP.

11. The bypass control shall include a programmable time delay for bypass start and keypad indication that this time delay is in process. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.

12. The user shall be able to select the text to be displayed on the keypad when an external safety opens. Example text display indications include “FireStat”, “FreezStat”, “Over pressure” and “Low suction”. The user shall also be able to determine which of the up to four (4) customer safety contacts is open over the serial communications connection.

13. Smoke Control Override Mode (Override 1) – The bypass shall include a dedicated digital input that will transfer motor from VFD mode to bypass mode upon receipt of a dry contact closure from the Fire / Smoke Control System. In this mode, the system will ignore low priority safeties and acknowledge high priority safeties as required by UL 864/UUKL. All keypad control, serial communications control, and normal customer start / stop control inputs will be disregarded. This Smoke Control Mode shall be designed to meet the intent of UL864/UUKL.

14. Fireman’s Override Mode (Override 2) – the bypass shall include a second, programmable override input which will allow the user to configure the unit to recognize selectable digital inputs. This programmability allows the user to program the bypass unit to react in whatever manner the local Authority Having Jurisdiction (AHJ) requires. The Override 2 action may be programmed for “Run-to-Destruction”. The user may also force the unit into Override 2 via the serial communications link.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be the responsibility of the contractor.

B. Power wiring shall be completed by the contractor, to NEC code 430.122 wiring requirements based on the VFD input current.

C. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the VFD installation manual.

3.2 START-UP

A. Certified factory start-up shall be provided for each drive by a factory authorized service center.
3.3 WARRANTY

A. The VFD Product Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. A toll free 24/365 technical support line shall be available.

END OF SECTION 239999
DIVISIONS 24 – 25
NOT USED
DIVISION 26
ELECTRICAL
PART I - GENERAL

1.1 WORK INCLUDED

A. Furnish and install all necessary labor, materials, tools and equipment to perform and completely finish the work according to the intent of this specification, and the accompanying drawings.

B. Provide conduit, wires and other miscellaneous materials, equipment and devices, not specifically mentioned in other sections of Division 26, but necessary and/or required for equipment or system operation of function.

C. Review all specification sections and drawings for equipment requiring electrical service. Provide service to and make connections to all such equipment requiring electrical service. Refer to other sections of Division 26 for connection requirements.

D. Drawings indicate design loads and voltages and corresponding control equipment, feeders, and overcurrent devices. If equipment actually furnished, other than for equipment provided by the University, have loads or voltages other than those indicated on the drawings or specified herein, control equipment, feeders, and overcurrent devices shall be adjusted in size accordingly at no additional cost to the University. Such adjustment shall be subject to the review of the University's Representative.

E. Provide connections of all equipment specified under this section and any other section and Division 23 including installation and connection of all relays, remote starters, etc. and the connection of all motors and controllers. Control wiring for Division 23 systems shall be provided by Division 23. Review Division 23 specifications and shop drawings for control systems to assure compatibility between equipment furnished under Division 26 and wiring furnished under Division 26. Motor controllers (starters) shall be furnished and installed under Division 26, unless specified to be furnished as an integral component of the equipment or unless controller is variable frequency drive type. Provide the number and type of auxiliary contacts necessary to interlock the equipment and provide the control sequence in Division 23.

F. Prior to electrical systems installation, Electrical Contractor shall provide a project test plan sequence coordinated with Master Project Schedule including demolition, new construction, startup, testing, and reports.

1.2 LOCAL CONDITIONS

A. Examine site; verify dimensions and locations against drawings and become informed of all conditions under which work is to be done before submitting proposal. No allowance will be made for extra expenses because of omission on Contractor's part to include cost of work under prevailing conditions.

B. Information shown relative to services is based upon available records and data shall be regarded as approximate only. Minor deviations found necessary to conform with actual locations and conditions shall be made without extra cost.

C. Extreme care shall be exercised in excavating near existing utilities to avoid any damage thereto; be responsible for any damage caused by such operations.
D. Request any utility shutdown, dig permit or road closure through the University's Representative, 14 days in advance. Include detailed procedure and proposed schedule. In each case approval must be obtained from the University's Representative for the requested shutdown time and work involved. Shutdown work shall be performed on overtime hours if so directed by the University.

E. Protect premise and work of other trades from damage arising out of installation of work of this division. If damage has occurred, repair or replace materials and parts of premises as directed by University's Representative at no cost to the University.

1.3 CODES AND STANDARDS

A. Applicable codes are those specified in Division 01 – Regulatory Requirements. Nothing in the Drawings or Specifications shall be construed to permit work not conforming to these codes, latest edition as adopted by authority having jurisdiction.

B. Material Standards: All material shall be new and shall conform to the standards where such have been established for the particular material in question. Publications and Standards of the organization listed are applicable to materials specified herein. Also refer to Division of these specifications: Insulated Cable Engineers Association (ICEA), Institute of Electrical and Electronic Engineers (IEEE), Edison Electric Institute (EEI), American Wood Preservers Association (AWPA), National Board of Fire Underwriters (NBFU), Illuminating Engineering Society (IES), Electrical Testing Laboratory (ETL).

C. Code compliance is mandatory - no information or details on the drawings or specifications permits work not conforming to code. Where work is shown to exceed minimum code requirements perform work per drawings and specifications.

D. Title 24, Part 6, Section 120.8 of the California Building Commissioning Guide.

1.4 DRAWINGS

A. The drawings indicate the arrangements of electrical equipment. Review architectural drawings and details for door swings, cabinets, counters and built-in equipment; conditions indicated on architectural plans shall govern. Coordinate installation of electrical equipment with structural system and mechanical equipment and access thereto. Coordinate installation of recessed electrical equipment with concealed ductwork and piping, and wall thickness.

B. Do not scale drawings. Obtain dimensions for layout of equipment from Architectural plans and details unless indicated on Electrical plans. Field measurements take precedence over dimensioned drawings.

C. Bring all discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions to the immediate attention of the University's Representative.

D. Equipment layout is based on one manufacturer's product or from composite dimensions from multiple manufacturers. Where equipment selected for use on the job differs from layout, coordinate space requirements and connection arrangements with Engineer. Equipment which exceeds specified maximum dimensions or which reduces required clearances shall not be accepted.

1.5 RECORD DRAWINGS
A. Upon completion of all Work, but before final acceptance, the Contractor shall furnish the University's Representative with complete sets of reproducible drawings updated and corrected to "as-built" conditions as specified. The contract documents drawings issued for bid shall be revised for "as-built" conditions. Include electronic panelboard files in Excel format updated to "as-built" conditions, copies of all submittal data, shop drawings, control Panel layout, point to point wiring diagram, conduit routing, underground duct banks, site lighting and any other detailed drawings.

B. All symbols, designations, and layers used in preparing Record Drawing shall match those used in Contract Drawings and electronic files.

C. Show all buried and concealed conduit, stub-outs, etc. Locate all buried conduit and stub-outs by dimensions from permanent, easily located and identifiable portions of structure; also, dimension ends of stub-outs, etc. Note depth of buried items below grade.

D. Provide "as-built" Basis of Design sequence of operations for power distribution system including automatic transfer system for emergency power, standby conditions, and restoration to normal utility following a utility interruption.

1.6 SUBMITTALS

A. Shop Drawings and Product Data:
   
   A. Submit for review by the University's Representative data of materials and equipment to be incorporated in the work. Submittals shall be supported by descriptive material, catalogs, cuts, diagrams, performance curves, and charts published by the manufacturer to show conformance to specification and drawing requirements; model numbers alone will not be acceptable. Provide complete electrical characteristics for all equipment. Submittals for lighting fixtures shall include Photometric data.

   B. Refer to the individual sections for identified equipment and materials for which submittals are required.

   C. Refer to Division 01 for required procedures.

   D. Provide work breakdown structure (WBS) for electrical and low voltage systems demolition and new work. WBS to include single line diagram. WBS to include detailed test plan sequence for existing panels to be de-energize, disposition of connected loads, and interrupting/de-energizing sequence for power system modifications. WBS to include in test plan sequence: Panels to be demolished and areas of impact, Interconnectivity with occupied areas and critical systems, New raceways/equipment to restore power distribution system capability, Schedule, Notifications, Risks assessment & mitigation plan.

   E. Utility shutdown: Provide utility interruption sequence with separate activities, durations for each activity, outcome, and risk assessment/impact mitigation plan for review and acceptance. Refer to section 01 31 00 for additional requirements.

   F. Provide for review, a functional test plan for each electrical and low voltage system to include the following: Description of the test procedure, and tester qualifications; Sample forms to include information
on each test results, test date, and ‘pass’/’fail’. Refer to Division 01 for additional commissioning requirements.

G. Provide for review, a test plan sequence for power, j-box, raceways, cabling, terminations, panelboards testing in preparation for energizing electrical and low voltage systems.

B. Operation and Maintenance Data and Instruction:

A. Refer to Division 01 for detail requirements.

B. Printed Material: Provide required printed material for binding in operation and maintenance manuals.

C. Instructions of University Personnel:

a. Before final inspection, as designated by the University's Representative provide a competent representative to instruct University's designated personnel in systems under this division of the specifications. For equipment requiring seasonal operation, perform instructions for other season within six months unless requested otherwise.

b. Use operation and maintenance manuals as basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

c. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.
PART II - PRODUCTS

2.1 MATERIALS

A. Materials mentioned herein or on drawings require that each item listed be provided and of quality noted, or an approved equal. All material shall be new, full weight and standard in all respects and in first-class conditions. Materials and equipment shall be uniform throughout the installation. Where possible, all materials used shall be of the same brand or manufacturer throughout for each class of material or equipment.

B. Grade or quality of materials desired is indicated by trade names or catalog numbers stated herein. Substitutions will be also be evaluated on maintenance track record and parts availability for previous installations that have been installed a minimum of five years. Refer to Division 01 Specification. Dimensions, sizes and capacities shown are a minimum and shall not be changed without permission of Engineer.

C. All electrical equipment and materials shall satisfy minimum requirements of NEMA, IEEE and ANSI standards. All materials must be UL approved, or if not covered by UL testing standards, shall be test and approved by an independent testing laboratory.

D. Work such as painting, patching, welding or carpentry related to the work of this Division shall be performed by the appropriate trade experienced in that work, but shall be provided for under this Division.

E. The following systems will be purchased and installed separately by the University. Provide all the conduit and outlet boxes required for complete installation under this contract. Provide input to and coordination with the University's Representative during the preparation of the shop drawings. Review shop drawings provided by University's Representative for installation information and provide comments as required. Installation of conduit and outlet boxes shall be governed by shop drawing requirements. All special system conductors will be provided and installed by the University; all conductors required for 120-volt power shall be provided under this contract. Notify the University's Representative of required dates for shop drawing completion and material delivery to coordinate with overall construction schedule. Specification sections contained herein are based on a complete system - individual components to be provided by the University are not identified other than by the requirements of this paragraph.

   A. Security Cameras and camera mounts.

   B. Surveillance system monitor stations.

   C. Emergency telephones (not including those installed within elevator cabs).

   D. Card access system.

PART III - EXECUTION

3.1 GENERAL

A. All electricians to be state certified and apprentices in an approved training program.

B. When changes in location of any work are required, obtain approval of University's Representative before making changes.

   A. Make changes at no extra cost.
C. Do not change indicated sizes without written approval of University’s Representative.

D. Provide all necessary offsets and crossovers in conduits, raceways, cabletrays and ducts.

E. Provide flexible connections of short length to installations or equipment subject to vibration or movement and to all motors. Provide a separate bonding conductor across all flexible connections.

F. Install exposed conduits parallel to walls and ceilings and vertically plumb, unless otherwise indicated.

G. Existing equipment or electrical wiring which is to remain, but has been removed to facilitate the installation of the new equipment, shall be restored to its original operating condition.

H. Where electrical items penetrate fire or smoke rated walls, ceilings and floors, comply with Section Division 7.

I. Before any cutting, burning, heating or other work that will emit smoke, dust or other products of combustion that may set off the fire alarm system, request a fire alarm system shutdown from the University’s inspector. This request shall be made at least 14 days prior to the date the shutdown is required. If this requirement is ignored and triggers the fire alarm system the offending party shall be responsible for all false alarm charges from the fire department. Instruct all personnel of this requirement before they are permitted on the job site. If the job site has a portable fire alarm system installed for the construction period, turn the system on and off each working day.

J. Provide concrete foundations or pads as follows for floor mounted electrical equipment where indicated on the drawings:

   A. Install minimum 4” high concrete pads or as indicated. Other pad dimensions shall be as required to accommodate the equipment installed.

   B. Use 3,000 PSI (14 Kg/s/mm) concrete.

   C. Refer to structural details for concrete pads requirements.

   D. Chamfer top edges ¾” (18mm).

   E. Make all faces smooth.

   F. Set anchor bolts for equipment. See structural Drawings.

   G. Coordinate the size of all pads, the location of all anchor bolts, and the location of all vibration isolators.

3.2 QUALITY ASSURANCE AND PROJECT SAFETY

   A. Provide quality assurance and project safety programs. Satisfy the minimum acceptable requirements provided in the specifications.

3.3 PREPARATION
A. Examine Drawings and Site; be familiar with types of construction where electrical installation is involved.

A. Work shall be neatly installed in a professional manner in accordance with NECA Standard of Installation. Work shall be coordinated with other trades to avoid conflicts. Clarifications will be made by University's Representative and minor adjustments shall be made without additional cost to University. Obtain clarification from University's Representative concerning any obvious discrepancies or omissions in work before bidding. All work involved in correcting obvious errors or omissions after award of Contract shall be performed as directed by University's Representative without additional cost to University.

B. Layouts of equipment, accessories and wiring systems are diagrammatic (not pictorial), but shall be followed as closely as possible. Drawings and Specifications are for assistance and guidance, and exact locations, distances, levels, etc., will be governed by Site.

C. Schedule of Values:

A. Refer to Division 01 for submittal requirements.

B. Provide a schedule of values for the electrical work specified under Division 26. Include separate labor and material itemization for each line item requested. The itemized schedule of values will be used to determine project completion and progress for payment requests, including overhead and profit for each itemization. Schedule of values must be submitted and approved prior to first pay request. Provide the following line items as a minimum level of itemization:

a. Electrical service and distribution (include all power equipment, i.e., panelboards, transformers, feeders, motor controllers, etc.).

b. Lighting systems (include all fixtures, lamps, branch circuiting, and lighting controls).

c. Devices (include all power outlets and branch circuit wiring not associated with lighting, motors, or equipment connections).

d. Equipment connections (include all wiring and connection to HVAC, elevators, etc., including controlling devices and feeders).

e. Basic work and materials (include work common to all systems, i.e., backboards, cutting and patching, demolition, temporary services, record drawings, permits, etc.).

f. Special systems (itemize separately, including emergency power supply system, grounding system, UPS equipment, etc.).

g. Communications/signalling systems (include all low voltage systems, itemized separately, i.e., fire alarm, sound paging, security, etc.).
3.4 WORKING SPACE

A. Provide adequate working space around electrical equipment in compliance with Article 4 of Electrical Safety Orders. In general, provide 36" minimum clear workspace in front of panelboards and controls.

   A. 36" @ 250V and less.
   
   B. 42" @ 250V to 600V.

3.5 PRODUCT DELIVERY, STORAGE, HANDLING, AND PROTECTION

A. Inspect materials upon arrival at Project and verify conformance to Contract Documents. Prevent unloading of unsatisfactory material including University furnished material. Handle materials in accordance with manufacturer's applicable standards and suppliers recommendations, and in a manner to prevent damage to materials. Store packed materials in original undamaged condition with manufacturer's labels and seals intact. Containers which are broken, opened, damaged, or watermarked are unacceptable and shall be removed from the premises and replaced at no additional cost to the University.

B. All material, except items specifically designed to be installed outdoors, shall be stored in an enclosed, dry building or trailer. Areas for general storage shall be provided. Provide temperature and humidity control where applicable. No material for interior installation, including conductors, shall be stored other than in an enclosed weathertight structure. Equipment stored other than as specified above shall be removed from the premises and replaced at no additional cost to the University.

C. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Conditions shall be those for which the equipment or materials are designed to be installed. Equipment and materials shall be protected from water, direct sunlight, cold or heat. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced at no additional cost to the University.

D. During construction, all equipment and materials shall be maintained and protected at all times in the original condition received from the manufacturer and according to the manufacturer's requirements.

3.6 CARE AND CLEANING

A. Any equipment and / or panel interior cleaning or corrective measures required as a result of improper exposure to the construction environment shall be submitted to the University for review and approval before the work proceeds. Cleaning and / or corrective measures for equipment and panel interiors shall include manufacturer’s requirements or recommendations.

B. Interior cleaning or corrective measures involving equipment and panels shall be completed by manufacturers or authorized representatives of manufacturers.
C. Remove oil, dirt, grease and foreign materials from all raceways, fittings, boxes, panelboard trims and cabinets to provide a clean surface for painting. Touch-up exterior scratched or marred surfaces of lighting fixtures, panelboard and cabinet trim, motor control center, switchboard or equipment enclosures with paint furnished by the equipment manufacturers specifically for that purpose.

D. Accessible elements of disconnecting and protective devices of equipment, coils of dry type transformers and the like shall be cleaned with compressed air (less than 15 PSI) and the enclosures vacuum cleaned prior to being energized.

E. Clean light fixtures and lamps thoroughly, just prior to final inspection. Fixture enclosures, shielding, etc., shall be cleaned by an approved method.

F. Do not paint trim covers for flush mounted panelboards, telephone cabinets, pull boxes, junction boxes and control cabinets unless required by the University's Representative. Remove trim covers before painting. Under no conditions shall locks or exposed trim clamps be painted.

G. Unless indicated on the drawings or specified herein to the contrary, all painting shall be done under the PAINTING Section of these Specifications.

H. Where plywood backboards are used to mount equipment provided under Division 16, paint backboards with two coats of light gray semi-gloss fire retardant paint under Division 26. Labels shall be left exposed and shall not be painted.

I. All broken, contaminated, damaged or otherwise defective parts, equipment, and materials shall be repaired or replaced without additional cost to the University. Work shall be left in a condition satisfactory to University's Representative. At completion, carefully clean and adjust all equipment, fixtures and trim installed as part of this work. Systems and equipment shall be left in a satisfactory operating condition.

J. All surplus materials and debris resulting from this work shall be periodically cleaned out and removed from site; this includes surplus excavated material.

3.7 EXCAVATING AND BACKFILLING

A. Excavate and backfill as required for installation of electrical work. Restore all surfaces, roadways, sod, walks, curbs, walls, existing underground installation, etc., cut by installations to original condition in an acceptable manner. Maintain all warning signs, barricades, flares and lanterns as required by the Safety Orders and local ordinances.

B. Excavation: Dig trenches straight and true to line and grade, with bottom clear of any rock points. Support conduit for entire length on undisturbed original earth. Minimum conduit depth of crown shall be 2' below finished grade.

C. Backfill: All backfill material shall be local material free of rubble, rubbish or vegetation. Trenches shall be backfilled and compacted to 90% of maximum dry density at optimum moisture content in layers not to exceed 6" when compacted.
3.8 CUTTING AND PATCHING

A. Provide necessary cutting and patching required to accomplish the work of Division 26.

B. Do not endanger the stability of the structure by cutting, drilling or otherwise modifying the structural members of the building. Direct all requests for structural modifications to the University's Representative for approval. Proceed with these modifications only as directed by the University's Representative.

C. Cutting and patching requirements will be modified only if General Construction Specifications and drawings specifically state that certain portions or all cutting and patching required for each of the various trades is to be performed.

D. Refer to General Construction Specifications for execution and requirements for patching and painting and comply with applicable provisions as to materials and quality of installation.

3.9 PROTECTION

A. In performance of work, protect work from damage. Protect electrical equipment, stored and installed, from dust, water or other damage.

3.10 EQUIPMENT IDENTIFICATION

A. Panelboards, remote control switches, terminal boxes, etc., shall be properly identified according to section 26 05 53 of these specifications.

3.11 RUST INHIBITER

A. Channels, joiners, hangers, caps, nuts and bolts and associated parts shall be plated electrolytically with zinc followed immediately thereafter by treating freshly deposited zinc surfaces with chromic acid to obtain a surface which will not form a white deposit on surface for an average of one hundred twenty (120) hours when subjected to a standard salt spray cabinet test, or shall be hot dipped galvanized.

3.12 ELECTRICAL SYSTEMS OPERATIONAL TESTS, MANUFACTURERS SYSTEMS CERTIFICATION AND DESIGN AUTHORITY ASSISTANCE

A. Testing:

   A. Provide tests specified in other sections. Test all wiring and connections for continuity and grounds; where such test indicate faulty insulation or other defects, locate, repair and retest. Balance loads at panelboards. Furnish all testing equipment.

   B. Refer to the individual specification sections of Division 01 and Division 26 for test requirements.

   C. Prior to the final inspection, the systems or equipment shall be tested and reported as therein specified. Five (5) typewritten copies of the tests shall be submitted to the University's Representative for approval. Testing does not replace the requirement for final inspection of the project work.

   D. All electrical systems shall be tested for compliance with the specifications.
B. Manufacturers Certifications:

A. The electrical systems specified herein shall be reviewed for compliance with these specifications, installation in accordance with the manufacturers recommendations and system operation by a representative of the manufacturer. The manufacturer shall submit certification that the system has been reviewed by the manufacturer, is installed in accordance with the manufacturer’s recommendations and is operating in accordance with the specifications.

B. Provide manufacturers certification for the following systems:

   a. Fire Alarm System
   b. Clock System
   c. Security Systems
   d. Intercom System
   e. Public Address System
   f. Lighting Control Systems
   g. Automatic transfer switches

C. Design Authority Assistance:

   a. Remove equipment covers (i.e. panelboard trims, motor controls, device plates, and junction box covers) as directed for inspection of internal wiring. Accessible ceilings shall be removed as directed for inspection of equipment installed above ceilings.

   b. Energize and de-energize circuits and equipment as directed. Demonstrate operation of equipment and systems as directed by the University's Representative.

   c. Provide authorized representatives of the manufacturers to demonstrate to the University's Representative compliance with the specifications of their respective system during or prior to the final inspection at a time designated by the University's Representative. Refer to the specific specification section for additional testing requirements. Representatives of the following systems are required for demonstrations:

      1) Fire Alarm System
      2) Intercom System
      3) Surveillance System
      4) Public Address System
      5) Lighting Control System
      6) Automatic Transfer Switches
3.13 CLOSING OF AN UNINSPECTED WORK

A. Do not allow or cause any of work installed hereunder to be covered up or enclosed before it has been inspected and approved.

B. Should any work be enclosed or covered up before it has been approved, uncover such work and after it has been inspected and approved, make all repairs necessary to restore work of others to conditions in which it was found at time of cutting, all without additional cost to the University.

3.14 TEMPORARY FACILITIES

A. Provide temporary shop office and storage space on site only at locations approved by the University's Representative. Remove these facilities upon completion of work.

3.15 NOISE AND VIBRATION

A. Cooperate in reducing objectionable noise or vibration. If noise or vibration occurs as a result of the use of improper material or installation, correct these conditions at no cost to the University.

END OF SECTION 26 00 10
SECTION 26 05 00
BASIC ELECTRICAL MATERIALS AND METHODS

PART I - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Adjust list below to suit Project.
   2. Electrical equipment coordination and installation.
   3. Sleeves for raceways and cables.
   4. Sleeve seals.
   5. Common electrical installation requirements.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications
B. EPDM: Ethylene-propylene-diene terpolymer rubber.
C. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. Test Equipment Suitability and Calibration: Comply with NETA ATS, “Suitability of Test Equipment” and “Test Instrument Calibration.”

1.6 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated “wall pipe,” equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section “Firestopping” and Contract Drawings.
2.3 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers:
   a. Calpico, Inc.
   b. Metraflex Co.
   c. Advance Products & Systems, Inc.
   d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

3. Pressure Plates: Carbon steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Firestopping" and Contract Drawings.

C. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

E. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

F. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

G. Cut sleeves to length for mounting flush with both surfaces of walls.

H. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

I. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require a different clearance.

J. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

K. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Caulking and Sealants" for materials and installation.

L. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."

M. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

N. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section “Firestopping” and Contract Drawings.

3.5 FIELD QUALITY CONTROL

A. Inspect installed sleeve and sleeve-seal installations and associated firestopping for damage and faulty work.

END OF SECTION 26 05 00
PART I - GENERAL

1.1 DESCRIPTION

A. The work required under this section of the specifications consists of the start-up testing and inspection of the electrical equipment designated within. All labor and testing equipment which is required shall be provided under this section of the specifications.

1.2 GENERAL

A. Perform the tests per Sections 01 45 00, 14 45 23, 01 75 00, Division 01 Commission section, and as outlined below to insure system acceptance and shall engage the services of approved testing organizations to provide start-up testing and inspection of the electrical equipment as specified in this section. The testing organizations may be an independent division of the manufacturer of the assembled products being tested. If an outside testing organization is approved, a representative of the manufacturer shall be under contract by the testing company. The representative shall be present during all testing to insure that the testing is performed properly and that any deficiencies discovered are promptly corrected.

B. The testing organization shall be a full service company that employs factory trained test engineers capable of trouble shooting as well as identifying equipment problems. All work outlined shall be performed under the full time on-site supervision of a graduate engineer with a minimum of five years of field-testing experience. The test, plan, procedures, and report shall be reviewed and approved by one of the testing company's electrical engineers. Upon request, the testing company shall submit proof of its qualifications.

C. The testing organization shall provide the equipment and technical personnel to perform such tests and inspections. Furnish any personnel necessary to assist in the testing and inspection.

D. When the tests and inspections have been completed, a label shall be attached to all devices tested. The label shall provide the name of the testing company, the date the tests were completed, and the initials of the engineer who performed the tests.

E. The tests shall insure that the equipment is operational and functioning within industry standards and manufacturer's tolerances. Forward all test reports to the University's Representative to least two weeks prior to the project final inspection for review. Reports shall be bound as required by Division 01 of this specification.

1.3 QUALITY ASSURANCE

A. The testing and inspection shall comply with all applicable sections of the following codes and standards:

1. American National Standards Institute – ANSI


3. Association of Edison Illuminating Companies – AEIC
4. Institute of Electrical and Electronics Engineers – IEEE
5. Insulated Power Cable Engineers Association – IPCEA
7. California Electrical Code – CEC
8. National Electrical Manufacturers Association – NEMA
10. State and Local Codes and Ordinances

B. The inspection and testing shall comply with the project plans and specifications as well as with the manufacturer's drawings, instruction manuals, and other applicable data for the apparatus tested.

C. *Comply with Underwriter Laboratory (UL) for testing and labeling of electrical distribution equipment.*

1.4 DIVISION OF RESPONSIBILITY

A. Perform routine insulation-resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.

B. Supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the specific power requirements.

C. Notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

D. Supply a complete set of electrical plans, specifications, and any pertinent change orders to the testing firm prior to commencement of testing.

E. Notify the University's Representative prior to commencement of any testing.

F. Any system, material or installation which is found defective on the basis of acceptance tests shall be reported to the University's Representative.

G. The testing firm shall maintain a written record of all tests and, upon completion of project, shall assemble and certify a final test report.

1.5 SAFETY AND PRECAUTIONS

A. Safety practices shall comply with applicable state and local safety orders as well as with the Occupational Safety and Health Act of 1970 (OSHA). Compliance with the Accident Prevention Manual for Industrial Operations of the National Safety Council shall be observed.

B. Tests shall only be performed on apparatus which is de-energized. The testing company's lead test engineer for the project shall be a designated safety representative.
and shall supervise testing observations and safety requirements. Work shall not proceed until the safety representative has determined that it is safe to do so.

C. Power circuits shall have conductors shorted to ground by a hotline grounded device approved for the purpose. Warning signs and protective barriers shall be provided as necessary to conduct the tests safely. Follow OSHA lockout/tagout standards.

1.6 REPORTS

A. The test report shall include the following sections:

1. Scope of testing.
2. Equipment tested.
3. Description of test.
4. Test results.
5. Conclusions and recommendations.
6. Appendix, including test forms.
7. Qualifications of testing agency.

B. Each piece of equipment shall be recorded on a data sheet listing the condition of the equipment as found and as left. Included shall be recommendations for any necessary repair or replacement parts. The data sheets shall indicate the name of the engineer who tested the equipment and the date of the test completion.

C. Record copies of the completed test report shall be submitted no more than 30 days after completion of the testing and inspection.

1.7 TEST EQUIPMENT

A. All test equipment shall be in good mechanical and electrical condition. All field instruments shall have been calibrated within six months of the testing date, and dated calibration labels shall be visible on the testing equipment. Submit calibration certification in the final report.

PART II - PRODUCTS

2.1 MATERIALS

A. All materials are specified under other sections of this specification. All testing equipment required shall be provided under this section of the specifications.

PART III - EXECUTION

3.1 EQUIPMENT TO BE TESTED

A. The following equipment shall be tested in accordance with the scopes of work which follow. The party responsible is identified in accordance with the following key: C = Contractor/Installer; M = Manufacturer; T = Testing Agency.
1. Dry Type Transformers – C
2. Molded Case Circuit Breakers – C
3. Motor Control Centers and Motor Controllers – C
4. Automatic Transfer Switches – T
5. Fire Alarm System – M
6. Grounding System – C
7. Cables, Low Voltage, 600 Volts Maximum – C
8. Ground Fault Systems – C
9. Medium Voltage Switchgear – T
10. Medium Voltage Switches – T
11. Low Voltage Switchgear and Switchboards – T
12. Low Voltage Power Circuit Breakers and Insulated Case Circuit Breakers – T
13. Lighting Control System – C
14. Medium voltage Cables, Terminations, and Splices – T
15. Public Address Systems – M
16. Intercom Systems – M
17. Security Systems – M

3.2 DRY TYPE TRANSFORMERS

A. Visual and Mechanical Inspection:

1. With case covers removed, inspect transformer core and coil assembly and enclosure interior. Cloth wipe and brush major insulating surfaces.
2. Check primary, secondary, and ground connections.
3. Check tap connections and tap changer.
4. Inspect all bolted connections. Torque wrench tighten or remake any questionable connections.
5. Inspect insulators, spacers, and windings.
6. Inspect for adequate electrical clearance.
7. Check base or support insulators, including vibration isolation supports.
8. Check accessory devices for condition and proper operation.
9. Verify that the transformers have been provided with adequate spacing for ventilation.

3.3 MOLDED CASE CIRCUIT BREAKERS

A. Visual and Mechanical Inspection:

1. Inspect cover and case, and check for broken or loose terminals.
2. Operate breaker to check operation.
3. Verify proper reporting of the events on the project equipment monitoring system.

B. Electrical Tests (400 ampere frame and larger):

1. Insulation Resistance Test: Megger main poles of breaker pole-to-pole, from each pole to ground, and across the open contacts of each pole.
2. Contact Resistance Test: Ductor across main pole contacts with breaker closed and latched to check for good, low resistance contact.
3. Test overcurrent trip device and calibrate. Where primary injection testing is specified, test each pole of the breaker individually. Data shall be compared with manufacturer’s published data.
   a. All trip units shall be tested by primary injection.
   b. Static overcurrent trip devices shall be tested per manufacturer’s instructions.
   c. Test for minimum pick-up current.
   d. Apply 300% of pick-up current and measure time necessary to trip breaker (long time delay).
   e. Where short time delay characteristics are provided, test short time pick-up and delay.
   f. Test instantaneous trip by passing current sufficiently high to trip breaker instantaneously.
   g. Where ground fault protection is provided, test ground fault pick-up and delay.
   h. Check reset characteristics of trip unit.
4. Electrically test any auxiliary devices such as shunt trips, undervoltage trips, alarm switches, and auxiliary switches.

3.4 MOTOR CONTROLLERS

A. Visual and Mechanical Inspection:

1. Verify that the structure interiors and starter cells have been cleaned of accumulated dust, dirt, oil films, and other foreign material.
2. Inspect bolted connections. Torque wrench tighten or remake any questionable connections.

3. Check mechanical operation of starters for freedom from binding.

4. Check motor circuit protector setting and overload relay heater size against manufacturer furnished list of actual motor nameplate full load current values.

5. Verify proper reporting of the events on the project equipment monitoring system.

B. Electrical Tests:

1. Verify operation of each starter.

2. Test each overload relay by current injection through relay heaters. Record heater catalog numbers for each starter and submit list for maintenance. List shall contain circuit number, description of equipment and motor full load amps.

3. Contact Resistance Test: Ductor across main pole contacts of each breaker or switch with device closed and latched to check for good, low resistance contact.

4. Test overcurrent trip device of each circuit breaker trip device by current injection.

3.5 AUTOMATIC TRANSFER SWITCHES

A. Visual and Mechanical Inspection:

1. Verify that enclosure interiors and all components have been cleaned of accumulated dust, dirt, oil films, and other foreign material.

2. Inspect all electrical and mechanical components for condition and any evidence of defect or failure.

3. Perform inspection checks on individual components as recommended by the manufacturer.

4. Inspect connections for looseness. Torque wrench tighten or remake any questionable connections.

5. Inspect for missing or loose hardware or accessories.

6. Check for proper mechanical operation and lubricate, as necessary.

7. Check transfer mechanism for alignment and friction-free operation. Lubricate, as necessary.

8. Check all connecting wiring for condition.

9. Verify proper reporting of the events on the project equipment monitoring system.

B. Electrical Tests:

1. Use test switch, when available, to check the electrical operation of the transfer switch.
2. When a test switch is not available, a failure of the normal source power will be simulated by disconnecting a voltage sensing lead.

3. Test and adjust all sensing relays, and other devices specifically associated with the transfer switch.

4. Contact Resistance Test: Ductor across main pole contacts of power switching circuit breakers, switches or contactor contacts with device closed and latched to check for good, low resistance contact.

3.6 FIRE ALARM SYSTEM

A. Visual and Mechanical Inspection:
   1. Inspect each device for physical damage.
   2. Check for proper labeling of conductors.
   3. Inspect all test switches for proper operation.
   4. Inspect all system lamps and LED's for proper operation. Replace all non-operational equipment.
   5. Check all cabinet doors latches and hinges for proper operation. Adjust, lubricate, and repair as required.
   6. Verify proper reporting of the events on the project equipment monitoring system.
   7. Perform smoke and heat detector testing for supervisory and annunciation circuits through existing reporting system.

B. Electrical Tests: Test each individual circuit at panel with equipment connected for proper operation. Entire system shall test free from opens, grounds, and short circuits. Verify control circuit integrity: Field tests to verify component compliance with specifications, adjusting, calibrating, and setting circuit breaker, relays, timers, etc. Testing will include, but not be limited to the following:
   1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
   2. Close each sprinkler system control valve and verify proper supervisory alarm at the FACP.
   3. Verify activation of all flow switches.
   4. Open initiating device circuits and verify that the trouble signal actuates.
   5. Open and short signaling line circuits and verify that the trouble signal actuates.
   6. Open and short indicating appliance circuits and verify that trouble signal actuates.
   7. Ground all circuits and verify response of trouble signals.
   8. Check presence and audibility of all alarm notification devices.
9. Check installation, supervision, and operation of all intelligent smoke detectors.

10. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

11. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

12. Check the integrity of the software program with the system in complete operation. Verify that each message reported is correct with respect to the signal received. All possible operating conditions and system troubles shall be tested. Rewrite software as required.

C. Ground tests shall meet requirements of Part 3, Title 24, CEC.

D. After completion of testing and adjustment, operate the different systems and equipment under normal working conditions and show specified performance. If, in the opinion of the University's Representative, performance of equipment or systems is not in accordance with Contract Documents or submitted data, alter or replace equipment at no increase in Contract Sum.

E. Do not allow or cause any work to be covered up or enclosed before it has been inspected and approved. Should any work be enclosed or covered up before it has been approved, uncover such work and after it has been inspected and approved, make all repairs necessary to restore work to condition in which it was found at time of cutting, all at no increase in Contract Sum.

3.7 GROUNDING SYSTEM

A. Visual and Mechanical Inspection:

1. Inspect wiring system outlet and junction boxes for proper grounding. Green grounding conductor shall be connected to outlet and junction boxes. Inspect a minimum of 5% of project boxes.

2. Verify connections of grounds for the secondary of separately derived grounding systems, i.e. at dry type transformers. Note type of connection, i.e. mechanical or exothermic.

3. Verify proper connection to all components of building service entrance grounding system. Note all system components which are interconnected and type of connection either mechanical or exothermic. Note depth of driven ground rods.

B. Electrical Tests (Small Systems):

1. Perform ground-impedance measurements utilizing the fall-of-potential method per ANSI/IEEE Standard 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System". Instrumentation utilized shall be specifically designed for ground impedance testing. Provide sufficient spacing so that plotted curves flatten in the 62% area of the distance between the item under test and the current electrode.
C. Equipment Grounds:

1. Utilize two-point method of IEEE Std. 81. Measure between equipment ground being tested and known low-impedance grounding electrode or system.

D. Electrical Tests (Large Systems):

1. When sufficient spacing of electrodes described above is impractical, perform ground-impedance measurements utilizing either the intersecting curves method or the slope method. (Ref. Nos. 40 and 41 in IEEE Std. 81.)

E. Test Values:

1. The main ground electrode system impedance-to-ground should be no greater than five (5) ohms. Equipment grounds, depending on size and length of grounding conductor, should be only fractionally higher than system ground.

3.8 CABLES - LOW-VOLTAGE - 600V MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect cables for physical damage and proper connection in accordance with single-line diagram. Prior to pulling cables, provide cable pull procedures to include crew qualifications, raceway cleaning procedures, and methods to be used for tension monitoring to ensure cable tension is within manufacturer's specified limits.

2. Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench.

3. Check cable color-coding with applicable specifications and National Electrical Code standards.

B. Electrical Tests:

1. Perform insulation-resistance test on each feeder on the riser diagram with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute.

2. Perform continuity test to insure proper cable connection.

C. Test Values:

1. Evaluate results by comparison with cables of same length and type. Investigate any values less than 50 megohms.

2. Provide a test report for each feeder which indicates the manufacturer's target values and actual test reading. Report shall indicated pass/fail for each feeder. Submit report to University's Representative for approval. Include test report in project maintenance manual.

D. Feeder Cables:
1. 600-volt feeder cables in the building and secondary service cables to the building shall be tested using a megohmeter, to measure the insulation resistance of each conductor in the circuit.

2. Disconnect all equipment switches, relays, buswork, transformers, etc.) from the cable being tested.

3. Tests to be performed in a dry area.

4. Clean and dry cable ends with a cloth moistened with a suitable solvent.

E. Cable Values: Cable values shall be established and provided by the cable manufacturer. Provide target value insulation resistance (IR) in megohms, based on 1000 ft. at 60°F.

F. Temperature Correction Factor: For temperatures above or below 60°F, a correction factor may have to be applied to determine the true IR value. However, if the measured IR of the system is equal to or greater than the calculated value, a correction factor is not needed.

G. Correct insulation deficiencies which show an insulation resistance of less than one megohm.

H. Test conductors with power off and impress a voltage of not less than 500 volts D.C.

I. Perform continuity tests on all conductors.

3.9 GROUND-FAULT SYSTEMS (CEC 230-95)

A. Visual and Mechanical Inspection:

1. Inspect for physical damage and compliance with drawings and specifications.

2. Inspect neutral main bonding connection to assure:

   a. Zero-sequence sensing system is grounded.

   b. Ground-strap sensing systems are grounded through sensing device.

   c. Ground connection is made ahead of neutral disconnect link on zero-sequence sensing systems.

   d. Grounded conductor (neutral) is solidly grounded.

3. Inspect control power transformer to ensure adequate capacity for system.

4. Manually operate monitor panels (if present) for:

   a. Trip test.

   b. No trip test.

   c. Nonautomatic reset.

5. Record proper operation and test sequence.
6. Set pickup and time-delay settings in accordance with the settings provided by the University's Representative.

7. Verify proper reporting of the events on the project equipment monitoring system.

B. Electrical Tests:

1. Measure system neutral insulation to ensure no shunt ground paths exist. Remove neutral-ground disconnect link. Measure neutral insulation resistance and replace link.

2. Determine the relay pickup current by current injection at the sensor and operate the circuit interrupting device.

3. Test the relay timing by injecting three hundred percent (300%) of pickup current, or as specified by manufacturer.

4. Test the system operation at fifty-seven percent (57%) rated control voltage, if applicable.

5. Test zone interlock systems by simultaneous sensor current injection and monitoring zone blocking function.

6. On multiple source, tie breaker, etc., systems, devise a simulation scheme that fully proves correct operation.

C. Test Parameters:

1. System neutral insulation shall be a minimum of one hundred (100) ohms, preferably one (1) megohm or greater.

2. Relay timing shall be in accordance with manufacturer's published time-current characteristic curves but in no case longer than one (1) second for fault currents equal to or greater than 3,000 amperes.

3. Relay pickup value shall be within +10% of setting and in no case greater than 1200A.

3.10 MEDIUM VOLTAGE SWITCHGEAR

A. Visual and Mechanical Inspection:

1. Verify that the enclosure interiors are clean of accumulated dust, dirt, films, and other foreign material.

2. Inspect and clean all bus and support insulators.

3. Inspect all electrical and mechanical components for condition and any evidence of defects or failure.

4. Exercise all active components. Lubricate as required.

5. Check for proper anchorage, required clearances, physical damage, and proper alignment.
6. Inspect bolted connections. Torque wrench tighten or remake any questionable connections.

7. Inspect for missing or loose hardware or accessories.

8. Inspect ground bus connections.

9. Operate key and door interlock devices to assure proper operation.

10. Verify proper reporting of the events on the project equipment monitoring system.

B. Electrical Tests:

1. Insulation Resistance Test. Megger main secondary bus and feeder circuits phase-to-phase and phase-to-ground.

2. Energize any space heater circuits to insure proper operation.

3. Perform phasing check on double-ended switchgear.

C. Instruments and Meter Tests:

1. Inspect panel mounted instruments and meters. Clean and check for calibration accuracy. Make minor adjustments, as necessary.

3.11 MEDIUM VOLTAGE SWITCHES

A. Visual and Mechanical Inspection:

1. Verify that the enclosure interiors are clean of accumulated dust, dirt, oil films, and other foreign material.

2. Inspect and clean all bus and support insulators.

3. Inspect all electrical and mechanical components for condition and any evidence of defects or failure.

4. Check and adjust switch for proper travel and alignment.

5. Inspect bolted connections and fuse holders. Torque wrench tighten or remake any questionable connections.

6. Inspect for missing or loose hardware or accessories.

7. Inspect ground bus connections.

8. Operate key and door interlock devices to assure proper operation.

9. Exercise all active components. Lubricate as necessary.

B. Electrical Tests:

1. Insulation Resistance Test: Megger main poles of switch pole-to-pole, from each pole-to-ground, and across the open contacts of each pole.
2. Contact Resistance Test: Ductor across each pole contact, including phase fuse and fuse holder, with switch closed, to check for good low resistance contact. Any unusually high reading shall be isolated as to source, and corrected.

3.12 LOW VOLTAGE SWITCHBOARDS

A. Visual and Mechanical Inspection:

1. Verify that the enclosure interiors have been cleaned of accumulated dust, dirt, oil films, and other foreign materials.
2. Inspect all electrical and mechanical components for condition and any evidence of defects or failure.
3. Check for proper travel and alignment of any drawout or plug-in circuit breakers.
4. Check breaker connections to bus.
5. Inspect bolted connections. Torque wrench tighten or remake any questionable connections.
6. Inspect for missing or loose hardware or accessories.
7. Inspect ground bus connections.
8. Operate key and door interlock devices to assure proper operation.
9. Verify proper reporting of the events on the project equipment monitoring system.

B. Electrical Tests:

1. Insulation Resistance Test: Megger main secondary bus and feeder circuits phase-to-phase and phase-to-ground.
2. Energize any space heater circuits to insure proper operations.

C. Check phase rotation with a Biddle phase rotation meter.

D. Instruments and Meter Tests:

1. Inspect panel mounted instruments and meters. Clean and check for calibration accuracy. Make minor adjustments as necessary.

3.13 LOW VOLTAGE POWER CIRCUIT BREAKERS AND INSULATED CASE CIRCUIT BREAKERS

A. Visual and Mechanical Inspection:

1. Remove each draw-out type circuit breaker.
2. Inspect arc chutes of power circuit breakers.
3. Inspect circuit breaker for defects or damage.
4. Inspect and check contacts. Check alignment, over-travel, and pressure. Adjust if necessary.
5. Inspect finger clusters on line and load stabs of draw-out circuit breakers.

6. Check for proper mechanical operation. Lubricate where necessary.

7. Check auxiliary devices for proper operation.

8. Check breaker racking device (if applicable) for alignment and friction-free operation. Lubricate if necessary.

9. Verify proper reporting of the events on the project equipment monitoring system.

B. Electrical Tests:

1. Insulation Resistance Test: Megger main poles of breaker pole-to-pole, from each pole to ground, and across the open contacts of each pole.

2. Contact Resistance Test: Ductor across main pole contacts with breaker closed and latched to check for good, low resistance contact.

3. Test overcurrent trip device by primary injection and calibrate to settings provided. Static overcurrent trip devices shall be tested per the manufacturer's instructions. Test each pole of the breaker individually. Data shall be compared with manufacturer's published data.
   a. Test for minimum pick-up current.
   b. Apply 300% of pick-up current and measure time necessary to trip breaker (long time delay).
   c. Where short time delay characteristics are provided, test short time pick-up and delay.
   d. Test instantaneous trip by passing current sufficiently high to trip breaker instantaneously.
   e. Where ground fault protection is provided, test ground fault pick-up and delay.
   f. Check reset characteristic of trip unit.
   g. Conduct pre-functional power system capacitance charging current measurement at the rated voltage on the longest feeder run between the primary and secondary power distribution panels. Provide a report of the test results for review prior to energizing.

4. Electrically test any auxiliary devices such as shunt trips, undervoltage trips, alarm contacts, and auxiliary contacts.

3.14 LIGHTING CONTROL SYSTEM

A. Visual and Mechanical Inspection:

1. Inspect each device for physical damage.

2. Check for proper labeling of conductors.
3. Inspect all system lamps and LED’s for proper operation. Replace all non-operational equipment.

4. Check all cabinet doors, latches, and hinges for proper operation. Adjust, lubricate, and repair as required.

B. Electrical Tests:

1. Verify the absence of unwanted voltages between circuit conductors and ground that would constitute a hazard or prevent proper system operation.

2. Meggar test all conductors (other than those intentionally grounded) for isolation from ground.

3. Test all conductors (other than those intentionally connected together) for conductor-to-conductor isolation using as insulation testing device.

4. The control unit shall be tested to verify it is in the proper operating condition as detailed in the manufacturer's manual.

5. Each control circuit shall be tested to confirm proper operation of the circuit. Monitor the system with all building equipment energized, such as variable speed controllers, to verify the absence of control inhibiting electrical noise.

3.15 MEDIUM VOLTAGE CABLES, TERMINATIONS AND SPLICES

A. Visual and Mechanical Inspection:

1. Visually inspect all primary cable terminations and splices.

2. Verify that splices and terminations are made and installed in accordance with the recommendations of the manufacturer of the specific cable, terminators and splice kits used on this project.

B. Electrical Tests:

1. Each section of primary cable shall be given a high voltage D.C. test after cables are installed, in accordance with ICEA test procedure for high voltage cable for the KV rating of the cable being tested. Conduct test with all splices made but without cables being connected to transformers. Open all apparatus switches and place load break elbows in parking stands so test results will be applicable to cable only. Test shall consist of the application of a D.C. voltage to cable section for a period of fifteen minutes and the leakage current recorded after 15, 30, 45 and 60 seconds and at one minute intervals thereafter for the complete period. Record test results graphically recorded for each cable section. Test data shall indicate cable section tested, temperature and relative humidity at the time tests are made.

3.16 INTERCOM SYSTEMS

A. Visual and Mechanical Inspection:

1. Inspect each device for physical damage.

2. Check for proper labeling of conductors.
a. Inspect all test switches for proper operation.

3. Inspect all system lamps and LED’s for proper operation. Replace all non-operational equipment.

4. Check all cabinet doors latches and hinges for proper operation. Adjust, lubricate, and repair as required.

B. Electrical Tests:

1. Verify the absence of unwanted voltages between circuit conductors and ground that would constitute a hazard or prevent proper system operation.

2. Megger test all conductors (other than those intentionally grounded) for isolation from ground.

3. Test all conductors (other than those intentionally connected together) for conductor-to-conductor isolation using as insulation testing device.

4. The control unit shall be tested to verify it is in the normal supervisory condition as detailed in the manufacturer's manual.

5. Each circuit shall be tested to confirm that the integrity of installed conductors is being properly monitored by a suitable response at the control unit. One connection each shall be opened at no less than 10% of all initiating devices and indicating appliances.

6. Systematically initiate specified functional performance items at each station including making all possible calls, acknowledgements, and responses, and performing all possible processing options for each incoming and outgoing call. For each item, observe related performance at all devices required to be affected by the item under all optional system settings and sequences. Observe all voice audio for routing, clarity, quality, freedom from noise and distortion, and proper volume level. All intended functions shall be tested in accordance with the manufacturer’s manual including all supplementary functions. Main and standby power supplies shall be tested.

7. Check the integrity of the software program with the system in complete operation. All possible operating conditions and system troubles shall be tested. Rewrite software as required.

8. Measure the ratio of signal to noise of each complete system at normal gain settings using the following procedure:

   a. Disconnect a speaker-microphone and replace it in the circuit with a signal generator using a 1000 Hz signal. Measure the ratio of signal to noise at another station.

   b. Minimum acceptable ratio is 45 dB.

3.17 PUBLIC ADDRESS SYSTEMS

A. Visual and Mechanical Inspection:

1. Inspect each device for physical damage.
2. Check for proper labeling of conductors.

3. Inspect all system lamps and LED's for proper operation. Replace all non-operational equipment.

4. Check all cabinet doors latches and hinges for proper operation. Adjust, lubricate, and repair as required.

B. Electrical Tests:

1. Verify the absence of unwanted voltages between circuit conductors and ground that would constitute a hazard or prevent proper system operation.

2. Megger test all conductors (other than those intentionally grounded) for isolation from ground.

3. Test all conductors (other than those intentionally connected together) for conductor-to-conductor isolation using an insulation testing device.

4. The amplifiers and preamplifiers shall be tested to verify it is in the normal supervisory condition as detailed in the manufacturer's manual.

5. Each circuit shall be tested to confirm the integrity of installed conductors is being properly monitored by a suitable response at the control unit. One connection each shall be opened at no less than 10% of all initiating devices and indicating appliances.

6. Systematically initiate each circuit including making all possible calls for each circuit, observe related performance at all speakers. Observe all voice audio for routing, clarity, quality, freedom from noise and distortion, and proper volume level. All intended functions shall be tested in accordance with the manufacturer's manual including all supplementary functions. Main and standby power supplies shall be tested.

7. Conduct a power outage test for entire system. Place system in a simulated normal operating condition. Turn off power to amplifiers and restore after 30 minutes. Observe system performance for proper functioning.

8. Measure the ratio of signal to noise of each complete system at normal gain settings using the following procedure:

   a. Disconnect a speaker-microphone and replace it in the circuit with a signal generator using a 1000 Hz signal. Measure the ratio of signal to noise at another station.

   b. Repeat the test for input from the telephone PBX system.

   c. Minimum acceptable ratio is 45 dB.

END OF SECTION 26 05 10
PART I - GENERAL

1.1 DESCRIPTION

A. The work required under this section includes single conductor cables and accessories for 2,001- to 35,000-volt electrical distribution systems.

1.2 QUALITY ASSURANCE

A. The following specifications and standards are incorporated into and become a part of this specification by reference:

1. Association of Edison Illuminating Companies (AEIC):
   a. AEIC CS 6 Specifications for Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 through 69 KV

2. Institute of Electrical and Electronics Engineers (IEEE):
   b. IEEE 48 Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations
   c. IEEE 400 Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field

3. International Electrical Testing Association (INETA):
   a. ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

4. National Electrical Manufacturers Association (NEMA):
   a. NEMA WC 26 Wire and Cable Packaging
   b. NEMA WC 3 Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
   c. NEMA WC 5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
   d. NEMA WC 7 Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
e. NEMA WC 8 Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

5. Underwriter's Laboratories, Inc. (UL):
   a. UL 486A Wire Connectors and Wiring Lugs for Use with Copper Conductors
   b. UL 1072 Medium Voltage Power Cable

6. California Code of Regulation (CCR)
   a. CCR, Title 24, California Electrical Code Part 3


8. ANSI/NFPA 70 National Electrical Code

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable:

1. Southwire Co.
2. General Wire
3. Pirelli Cable

C. Installer Qualifications: Engage an experienced Installer of medium-voltage electrical cable to perform the installation specified in this section. Installer shall verify a minimum of five similar projects on which the individual was employed in a similar capacity, including references for each project.

D. Field Testing Organization Qualifications: To qualify for acceptance, an independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division One Specification Sections:

1. Product data on cables and cable accessories including descriptions and detailed specifications.
2. Shop drawings of splices and terminations.
3. Product certificate signed by manufacturer that its products comply with the specified requirements.
4. Installer certificates signed by manufacturer of cable splicing and terminating products that installers comply with training requirements specified under “Quality Assurance”.

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5. Signed installer certificates verifying that Installers of cable splices and terminations meet the experience qualifications specified under “Quality Assurance”.

6. Product Test Reports: Certified reports of manufacturers' factory production and final tests indicating compliance of cable and accessories with referenced standards.


8. Samples: 16” long of each type of cable specified.

9. Maintenance data for cables and accessories for inclusion in Operation and Maintenance manual specified in Division 1 and in Division 16 Section "Basic Electrical Requirements". In addition to the requirements specified there, include:
   a. Manufacturer's written instructions for periodic tests of cables in service.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver medium-voltage cable on factory reels conforming to NEMA Standard WC 26, "Wire and Cable Packaging".

B. Store cables on reels on elevated platforms in a clean, dry location.

PART II - PRODUCTS

2.1 MEDIUM-VOLTAGE CABLE

A. General: Cable shall be single-conductor type, size as indicated, and conforming to UL Standard 1072 "Medium Voltage Power Cables".

B. Cable shall be ethylene-propylene rubber (EPR) insulated and shall conform to the Association of Edison Illuminating Companies (AEIC) Standard CS6, "Specifications for Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 through 69 kV".

C. Conductors: Class B stranded, annealed copper.

D. Cable Jacket: Cross-linked polyolefin.

E. Metallic Shielding: Copper shielding tape, helically applied over semi-conducting insulation shield.

F. Cable Voltage Rating: 15 kV phase to phase.

G. Insulation Thickness: Corresponding to 133% insulation level in accordance with the referenced standard.

PART III - EXECUTION

3.1 EXAMINATION

A. Examine raceways, cable trays, pull boxes, manholes, junction boxes, and other cable installation locations for cleanliness of raceways, minimum bending radii of cables, and conditions affecting performance of cable.
3.2 INSTALLATION, GENERAL

A. General: Install cable accessory items in accordance with manufacturer's written instructions and as indicated.

B. As required, remove water from raceways, pull boxes, and/or vaults prior to installing cable.

3.3 INSTALLATION OF CABLES

A. Pull conductors simultaneously where more than one cable is indicated in same raceway. Use UL listed and manufacturer-approved pulling compound or lubricant where necessary. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

B. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips that will not damage cables or raceways. Do not use rope hitches for pulling attachment to cable.

C. Install exposed cable parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

D. In manholes, handholes, pull boxes, junction boxes and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag.

3.4 GROUNDING

A. Ground shield of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated connector fittings, and hardware in accordance with manufacturer's written instructions.

3.5 IDENTIFICATION

A. Identify cable in accordance with Division 26 Section "Identification for Electrical Systems".

3.6 FIELD QUALITY CONTROL


B. Preparation: Perform the following preparations in advance of independent tests:

1. Test cables' insulation resistance.

2. Test circuits' continuity.

3. Furnish a set of Contract Documents and manufacturer's recommendations to test organization.
4. Make power available at test locations.

C. Schedule tests and notify University's Representative at least two weeks in advance of schedule for test commencement.

D. Test procedure shall conform to the following:

1. Independent Testing Organization: Arrange and pay for the services of an independent electrical testing organization in accordance with the requirements of Division 26 Section "Electrical Equipment Acceptance Testing" to perform tests on medium-voltage cable.

2. Test Objectives: To assure cable installation is operational within industry and manufacturer's tolerances, is installed in accordance with Contract Documents, and is suitable for energizing.

3. Procedures: Comply with the INETA standard and IEEE 400. Upon satisfactory completion of tests, attach a label to tested components.

E. Tests shall include high-potential test of cable and accessories and such tests and examinations required to achieve specified objectives.

F. Reports: The testing organization shall maintain a written record of observations and tests, report defective materials and installations, and retest corrected defective items. Testing organization shall submit written reports to the University's Representative.

END OF SECTION 26 05 13
PART I - GENERAL

1.1 DESCRIPTION

A. The work required under this section of the specification consists of all primary terminating devices, splices, and accessories as required for the project or as indicated on the drawings. All materials and devices shall be provided under this section of the specifications.

B. The types of primary terminations and splices are for a 15 KV primary cable system and its connection to medium voltage metal-clad switchgear and the primary side of secondary unit substations.

1.2 QUALITY ASSURANCE

A. The following specifications and standards are incorporated into and become a part of this specification by reference:

1. Institute of Electrical and Electronics Engineers (IEEE):
   a. 48  Standard Test Procedures and Requirements of High-Voltage Alternating-Current Cable Terminations
   b. 400  Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field
   c. 592  Standard for Exposed Semiconducting Shield on Premolded High-Voltage Cable Joints and Separable Insulated Connectors

2. International Electrical Testing Association (INETA):
   a. ATS  Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

3. Underwriters Laboratories, Inc. (UL):
   a. UL 486A  Wire Connectors and Wiring Lugs for Use with Copper Conductors

B. Acceptable Manufacturers: Products of the following manufacturer which comply with these specifications are acceptable.

1. Electrical Products Division, 3M
2. M.P. Husky Corp.
C. Installer Qualifications: All primary cable terminations and splices shall be made by a cable splicer having not less than five (5) years experience in splicing cables and making terminations of the type specified herein on system with rated voltage not less than the primary system specified. Name and experience record of cable splicer shall be submitted for approval with shop drawings, including references from past projects.

D. Coordination: Review shop drawings submitted under this and other sections to ensure coordination between different types of equipment.

1.3 SUBMITTALS

A. Refer to the "Basic Electrical Requirements" Section for submittal requirements.

B. Product Data: Submit manufacturer's technical product data including, but not limited to, specifications, rated BIL, rated BSL, insulation class, maximum and minimum cable conductor diameter, maximum and minimum cable insulation diameter, maximum design voltage to ground, and termination class.

C. Shop Drawings: Submit manufacturer's dimensional drawings of all terminations indicating location of cable connections, required clearances, and method of field assembly.

D. Maintenance Data: Submit maintenance data and parts list for each splice and termination type. Include that data, product data, and shop drawings in maintenance manual in accordance with requirements of Division 01.

E. Factory Test Data: Provide factory test data certified by Professional Engineer that test results fulfill specified requirements. All routine and quality assurance tests performed by the manufacturer, including dielectric testing, shall be submitted. Results of the above tests shall be submitted with final drawings in the form of certified test reports.

F. Contractor shall submit splice kits and loadbreaks cut sheets with complete installation manual information to University for review and acceptance as required.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver cable terminations and splice kits properly packaged in factory-fabricated containers. Store equipment in a clean dry space. Protect from dirt, fumes, water, and construction debris and traffic. Do not install damaged equipment; replace and return damaged units to equipment manufacturer.

PART II - PRODUCTS

2.1 SPLICES

A. Types: Compatible with the cable materials.

B. Connectors: Compression type as recommended by cable or splicing kit manufacturer for the application. Comply with IEEE 404.

C. Splicing and Terminating Kits: As recommended by the manufacturer in writing for the specific sizes, ratings, and configurations of cable conductor, splices, and terminations specified. Kits shall contain all components required for a complete splice or termination including detailed instructions and shall be the product of a single manufacturer.
Complete splices and terminations shall provide insulation equivalent to the insulation class of the cable it connects.

D. Splices shall be made with standard kits and shall be one of the following types:
   1. Premolded, cold shrink rubber, inline splice kit.
   2. Premolded ethylene propylene diene monomer (EPDM) splice body kit with cable joint sealed by interference fit of mating parts and cable.

2.2 CABLE TERMINATIONS

A. Conductor Terminations, General: Comply with Class 1 of IEEE Standard 48. Insulation class shall be equivalent to that of the cable upon which they are installed. Terminations for shielded cables shall include a shield-grounding strap. Termination kits shall be performance tested for compliance with IEEE Standard 48 and shall be of the following types:
   1. Class 1 Termination for Shielded Cable: Modular type, furnished as a kit, with stress relief tube, multiple molded silicone rubber insulator modules, shield ground strap, compression-type connector, and end seal.

2.3 ARC-PROOFING MATERIALS

A. Tape for first course on metal objects shall be 10-mil-thick, corrosion-protective, moisture-resistant PVC pipe-wrapping tape.
B. Arc-proofing tape shall consist of a UL-listed fireproofing tape. Tape shall be flexible, conformable, intumescent to 0.3-inches thick, and compatible with the cable jacket on which used. Tape shall be self-extinguishing and shall not support combustion.
C. Glass cloth tape shall be pressure-sensitive adhesive type, ½” wide.

PART III - EXECUTION

3.1 INSTALLATION, GENERAL

A. General: Install cable accessory items in accordance with manufacturer's written instructions and as indicated.

3.2 INSTALLATION OF SPLICES

A. Install splices at pull points and elsewhere as indicated using standard kit. Conform to kit manufacturer's written instructions.

3.3 INSTALLATION OF TERMINATIONS

A. Install terminations at ends of conductors. Conform to manufacturer's written instructions. Comply with class of terminations indicated.
B. Tighten electrical connectors and terminals in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

3.4 INSTALLATION OF CABLE ACCESSORIES
A. Arc-Proofing: Arc-proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials except where indicted. Apply as recommended by the manufacturer of the arc-proofing tape and the following:

1. Clean cable sheath.
2. Wrap metallic cable components with 10-mil-pipe wrapping tape.
3. Smooth surface contours with electrical insulation putty.
4. Apply arc-proofing tape in one half-lapped layer with coated side toward the cable.
5. Band the arc-proofing tape with 1” wide bands of half-lapped adhesive glass-cloth tape 2” on center.

3.5 GROUNDING

A. Ground shields of shielded cable at terminations and splices. Ground metal bodies of terminators, splices, and hardware in accordance with manufacturer's written instructions.

3.6 IDENTIFICATION

A. Identify cable in accordance with Division 26 Section "Electrical Identification".

3.7 FIELD QUALITY CONTROL


B. Preparation: Perform the following preparations in advance of independent tests:

1. Test cables' insulation resistance.
2. Test circuits’ continuity.
3. Furnish a set of Contract Documents and manufacturer's recommendations to test organization.
4. Make power available at test locations.

C. Schedule tests and notify University's Representative at least two weeks in advance of schedule for test commencement.

D. Test procedure shall conform to the following:

1. Independent Testing Organization: Arrange and pay for the services of an independent electrical testing organization in accordance with the requirements of Division 1 Section "Quality Control Services" and Section 26 05 10 "Electrical Equipment Acceptance Testing" to perform tests on medium-voltage cable.
2. Test Objectives: To assure cable installation is operational within industry and manufacturer's tolerances, is installed in accordance with Contract Documents, and is suitable for energizing.

3. Procedures: Comply with the INETA standard and IEEE 400. Upon satisfactory completion of tests, attach a label to tested components.

E. Tests shall include high-potential test of cable and accessories and such tests and examinations required to achieve specified objectives. Where new cables are spliced to existing cables, the high-potential test shall be performed on the new cable prior to splicing. After test results for new cables are approved and splice is made, submit an insulation resistance test and continuity test on the length of cable including the splice with the existing cables being tested to the nearest disconnect point.

F. Reports: The testing organization shall maintain a written record of observations and test, report defective materials and installations, and retest corrected defective items. Testing organization shall submit written reports to the University's Representative.

END OF SECTION 26 05 13.1
PART 1 - GENERAL

1.1 DESCRIPTION

A. The work required under this section of the specifications consists of furnishing, installing and connecting the building wiring system, 600 volts and below. Exterior branch circuit wiring and feeder conductors extended beyond the building are included. Wiring systems for communication and alarm systems are not included in this section unless specified to be included, by reference, in the respective specification sections for alarm and communication systems.

1.2 RELATED WORK

A. Section 26 05 33 – Conduit

1.3 QUALITY ASSURANCE

A. Industry Reference Standards. The following specifications and standards are incorporated into and become a part of this Specification by Reference.

1. Underwriters’ Laboratories, Inc. (UL) Publications:
   a. No. 83 Thermoplastic - Insulated Wires
   b. No. 486 Wire Connectors and Soldering Lugs
   c. No. 493 Thermoplastic - Insulated Underground Feeder and Branch Circuit Cables
   d. No. 854 Service Entrance Cables

2. Insulated Cable Engineers Association Standards (ICEA):
   a. S-61-402 Thermoplastic Insulated Wire and Cable

3. National Electrical Manufacturer's Standards (NEMA):
   a. WC-5 Thermoplastic Insulated Wire and Cable
   b. WC-26 Wire and Cable Packaging

4. UBC Standard 4-1 for non-combustible materials for wires and cables above non-sprinklered ceilings.

B. Acceptable Manufacturers: Products produced by the following manufacturer's which conform to this specification are acceptable.

1. Hydraulically applied conductor terminations:
   a. Scotch (3M)
2. Mechanically applied (crimp) conductor terminations:
   a. Scotch (3M)
   b. Thomas and Betts (T&B)
   c. or equal

3. Vinyl electrical insulating tape:
   a. Scotch (3M)
   b. Tomic
   c. or equal

4. Twist-On Wire Connectors:
   a. Buchanan
   b. Ideal
   c. or equal

5. Encapsulated insulating kits:
   a. Essex Group, Inc.
   b. Raychem
   c. Scotch (3M)
   d. or equal

6. Portable cable fittings:
   a. Crouse Hinds
   b. T & B
   c. or equal

7. Insulated cable:
   a. Pirelli Cable Corp.
   b. Southwire Co.
   c. General Wire
d. or equal

C. Performance: Conductors shall be electrically continuous and free from short circuits or grounds. All open, shorted or grounded conductors and any other damaged insulation shall be removed and replaced with new material free from defects.

D. Delivery, Storage and Handling: Deliver wire and cable in accordance with NEMA WC-26. Wires and cables shall not be stored in an exterior or unprotected location. Material subject to direct exposure to the elements shall be replaced and removed from the project. Bring wire to job in original unbroken packages. Obtain approval of University's Representative before installation of wires.

1.4 SUBMITTALS

A. Submit shop drawings in accordance with the Conditions of the Contract and Division One Specifications Sections for the conductors, terminations, connectors, insulating tape, and insulating kits.

B. Submit field test reports indicating and interpreting test results required by the "Electrical Equipment Acceptance Testing" section of these specifications.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS REQUIREMENTS

A. Provide all materials under this section of the specifications.

B. All wire and cable shall be UL listed and shall bear a UL label along the conductor length at intervals not exceeding 24 inches.

C. All conductors shall have size, grade of insulation, voltage and manufacturer's name permanently marked on the outer cover at intervals not exceeding 24 inches.

D. Conductor size shall be a minimum of No. 12 AWG. Conductor size shall not be less than indicated on the drawings. The minimum size of emergency systems conductors shall be No. 10 AWG.

E. Insulation voltage level rating shall be 600 volts.

F. All conduit and conductor sizes indicated on the drawings are based upon copper conductors. 60C ampacities shall be used for sizing of all wire and cable for branch circuits and feeders rated below 125 amps. 75C ampacities shall be used for sizing of all wire and cables for feeders rated 125 amps and above.

G. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.

2.2 PRODUCT/MATERIALS DESCRIPTION – CONDUCTORS

A. Conductors shall be stranded copper, 90°C, type THHN/THWN or XHHW unless otherwise indicated on the drawings, required by the California Electrical Code, or specified herein.

B. Fixture wire shall be No. 16 AWG silicone rubber insulated, stranded fixture wire, type SFF-2 (150°C), or No. 16 AWG thermoplastic, nylon jacketed stranded fixture wire, type TFFN
C. Control conductors for use on 120 volt control wiring systems shall be No. 12 AWG stranded type THHN/THWN, where properly protected, unless indicated otherwise on the drawings. Switch legs are not considered control wiring.

D. Portable power cables and outlets shall be provided where indicated on the drawings. Cables shall be sized as indicated on the drawings with equal size green equipment ground. Cables shall be jacketed 600 volt SO type. Cable connectors shall be steel case liquid tight sized for cable diameter and shall use strain relief gland fitting to prevent tension on conductor terminals. Where cable drops are indicated on the drawings, use wire mesh strain relief cable grips at both ends of cable. Use cast type outlet device box for device cable drops.

E. Wire shall be 1991 Code type copper wire of not less than 98% conductivity. All wires shall be stranded. Wires shall bear the Underwriters' label, be color coded and be marked with gauge, type and manufacturer’s name on 24" centers.

2.3 SPLICES, TAPS, AND CONNECTORS

A. Splices, taps and connectors (No. 10 AWG and smaller) - Splices and joints shall be twisted together electrically and mechanically strong and insulated with approved type insulated electrical spring connectors.

B. Splices, taps and connectors (No. 8 and larger) - Joints and connections shall be made with Burndy, T & B, or equal, solderless tool applied pressure lugs and connectors. Uninsulated lugs and wire ends shall be insulated with layers of plastic tape equal to insulation of wire and with all irregular surfaces properly padded with "Scotchfil", 2nd product or equal putty prior to application of tape. Tape shall be equal to Scotch #33, General Electric #AW-1, or equal. Feeder splicing, where permitted, shall be made with high compression sleeve type connector followed by manufactured splicing kit utilizing as insulators, resins poured into a ready-to-use plastic mold to provide a uniform, moisture-proof tough, impact-resistant insulation. Hydraulically applied crimping sleeve or tap connector sized for the conductor. Insulate the hydraulically applied connector with 90°C, 600 volt insulating cover provided by the connector manufacturer. Insulator materials and installation shall be approved for the specific application, location, voltage and temperature and shall not have an insulation value less than the conductor being joined.

C. Electrical insulating tape shall be 600 volt, flame retardant, cold and weather resistant, minimally .85 mil thick plastic vinyl material; Scotch No. 88, Tomic No. 85, Permacel No. 295, or equal.

PART 3 - EXECUTION

3.1 EXECUTION

A. Install all wiring in raceway system, except where conductors are indicated or specified not to be installed in raceway. Any conductors found to be damaged or defective, including insulation damaged during installation, shall be removed and replaced at no expense to the University.

1. Pull conductors into raceway simultaneously where more than one is being installed in the same raceway.
2. Use UL listed pulling compound or lubricant where necessary to reduce cable pulling tension below the manufacturer's recommended levels. Compound used shall not deteriorate conductor or insulation.

3. Use pulling means, including fish tape, cable rope, or basket-weave wire/cable grips that will not damage cable or raceway.

B. Connect all conductors. Torque each terminal connection to the manufacturer's recommended torque value. A calibrated torqueing tool shall be used to insure proper torque application.

C. Do not install more conductors in a raceway than indicated on the drawings. A maximum of three branch circuits are to be installed in any one conduit, on 3 phase 4 wire system, unless specifically indicated otherwise on the drawings. No two branch circuits of the same phase are to be installed in the same conduit, unless specifically indicated on the drawings.

D. Conductors shall be tested to be continuous and free of short circuits and grounds.

E. Maintain phase rotation established at service equipment throughout entire project.

F. Group and lace with waxed linen lacing cord (T & B "Ty-Rap", Holub "Quik-Wrap" or equal) all conductors within all enclosures, i.e., panels, motor controllers, equipment cabinets, switchboards, etc.

G. Splices in homerun conductors to panelboards, switchboards, switchgear, motor control centers, motor control enclosures, and other panels are not permitted, unless approved in writing by University's Representative. Make approved splices in conductors only within junction boxes, wiring troughs and other enclosures as permitted by the California Electrical Code. Do not splice conductors in pull boxes, panelboards, safety switches, switchboard, switchgear, motor control center, or motor control enclosures.

H. Splices in conductors installed below grades are not permitted, unless approved in writing by the University's Representative. For taps indicated on the drawings and approved splices below grades, connections shall be made in flush mounted watertight junction box with crimp connectors and watertight resin encapsulating insulating kit. Service entrance conductors shall not be spliced.

I. Support conductors installed in vertical raceways at intervals not exceeding those distances indicated in the California Electrical Code. Support conductors in pull boxes with bakelite wedge type supports or "Kellem" grips or equal, provided for the size and number of conductors in the raceway. Do not splice conductors in pull boxes used for vertical cable supports unless written permission for splicing is obtained. Where splicing is permitted, make splice with hydraulically applied splicing sleeve.

J. Make connections between fixture junction box and fixture with fixture wire.

K. Control, communications or signal conductors shall be installed in separate raceway systems from branch circuit or feeder raceway, unless indicated otherwise on the drawings.

L. Conductor lengths for parallel circuits shall be equal. Do not configure isolated phasing in separate conduits for parallel conductors.

M. Install a minimum of twelve inches (300 mm) of slack conductor at each outlet.

N. Thoroughly clean conductors prior to installing lugs and connectors.
O. Secure portable cables in accordance with the CEC. Install strain relief devices to prevent tension on terminations if cable is pulled. Install cable grips on drops and connect to outlet box or structure. Leave slack cable loop at drop point.

P. Conductors removed from conduit for any reason after installation shall replaced with new and shall not be re-installed.

3.2 IDENTIFICATION

A. Color Code Conductors:

1. Color code all secondary service, feeder and branch circuit conductors. Control and signal system conductors need not be color coded.

2. Coding shall be as follows:

   a. 208Y/120 volt three phase four wire wye system - Phase A: Black, Phase B: Red, Phase C: Blue, Neutral: White, Travellers: Orange.

   b. 480Y/277 volt three phase four wire system - Phase A: Brown, Phase B: Violet, Phase C: Yellow, Neutral: Gray, Travellers: Pink.

   c. Grounding conductors shall be green. Grounding conductors for isolated ground circuits shall be green with a yellow trace.

3. Phase conductors No. 10 and smaller shall have solid color compound insulation or color coating. Phase conductors No. 8 and larger shall have solid color compound, color coating or colored phase tape. Colored tape shall be installed on conductors in every box, at each terminal point, cabinet, through manhole or other enclosure.

B. Conductors within pull boxes shall be grouped and identified with nylon tie straps with circuit identification tag.

C. Identify each control conductor at its terminal points with wrap around tape wire markers. I.D. to indicate terminal block and point designation, or other appropriate identifying indication.

D. Refer to ELECTRICAL IDENTIFICATION section of these specifications for additional identification requirements.

3.3 TESTING

A. Refer to Electrical Equipment Acceptance Testing section of this specification for testing requirements.

END OF SECTION 26 05 19
SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Power System Grounding.
   2. Electrical Equipment and Raceway Grounding and bonding.
   3. Telecommunications Systems Grounding.

1.2 SUBMITTALS

A. Submit a complete set of marked-up record drawings to indicate installed location of system grounding electrode connections, and routing of grounding electrode conductor.

B. Submit certified test results stating ground resistance from service neutral at service entrance.

1.3 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA).

B. American National Standards Institute (ANSI).

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Burndy Engineering Company

B. Ilsco Corporation

C. Oz Gedney

D. Appleton.

E. or equal

2.2 MATERIALS

A. Ground Rods: Copper encased steel, \(\frac{3}{4}\)" diameter, minimum length – 10’. Provide chemical ground rod where shown on Contract Drawings. Chemical ground rod shall be HARGER type manufacturer or approved equal.

B. Ground Clamp: Water pipe connection, bronze two piece with serrated jaws, lug sized for grounding electrode conductor.

C. Connectors, Compression Type: Bronze or Copper, pretreated with conductive paste, sized
for conductor to which applied.

D. Connectors, Exothermic Weld Type: Powder actuated weld. Bond made through exothermic reaction producing molten copper from premixed copper oxide and aluminum powder. Form bond in mold or crucible.

E. Grounding Electrodes: As shown and as required by CEC Article 250.

F. Grounding Electrode Conductors: Bare copper underground or insulated copper aboveground and as required by CEC Article 250.

G. Bonding Conductors: Bare copper underground or insulated copper above ground and as required by CEC Article 250.

2.3 SECONDARY GROUNDING SYSTEM

A. The grounding system shall be provided as shown and shall meet the requirements of CEC Article 250. New systems shall include concrete-encased electrodes consisting of bare copper conductors placed in the bottom of the structural footings. In addition to the major components shown and required by Article 250, the grounding system shall include all fittings, connectors, devices, and material necessary for a complete and useable system. Bond the grounding system to all building columns in new construction. Bond the grounding system to all building columns as shown in existing construction.

B. Except where specifically indicated otherwise, all exposed noncurrent carrying metallic parts of electrical equipment, metallic raceways systems, grounding conductor in nonmetallic raceways and neutral conductor of the wiring system shall be grounded. The ground connection shall be made at the main service equipment of each service and shall be extended to all required components of CEC Article 250.

2.4 GENERAL BRANCH CIRCUITS GROUNDING

A. All grounding conductor wire shall be insulated green copper conductors.

B. All conduit bushings shall be grounding type.

C. All grounding connections shall be made with solderless lugs and nonferrous hardware.

2.5 CONDUIT BANK GROUNDING

A. Provide a minimum size 4/0 bare copper equipment grounding conductor for each of the campus utility distribution conduit banks shown on drawings. Install this equipment grounding conductor parallel to the respective conduit bank.

2.6 EQUIPMENT GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding and bonding conductors shall be separately provided and the functions shall not be combined in a single conductor.

PART 3 - EXECUTION

3.1 INSTALLATION OF THE MAIN SERVICE ENTRANCE GROUND

A. Provide a main service entrance grounding system with cables, connections, and ground
buses as shown on the drawings and specified. Provide all necessary materials and testing of the grounding system. **Install chemical ground rod system per manufacturer requirement as required.**

B. Where available the incoming water service, sprinkler system piping, building steel, under slab grounding electrodes, structural footing grounding electrodes, ground rod, and grounding ring encircling the building shall all be bonded together to form a grounding electrode system per CEC Article 250.

C. Provide the grounding system to obtain a ground resistance of the grounding grid not to exceed 5 ohms. Provide testing of the ground grid to obtain a ground resistance rating. If the resistance exceeds 5 ohms, contact the University's Representative for review of installation and additional procedures.

3.2 CONCRETE - ENCASED GROUNDING ELECTRODE (UFER GROUND)

A. The UFER ground shall consist of a continuous bare copper conductor of minimum length 60' provided in the bottom of the structure foundation footing.

3.3 GENERAL BRANCH CIRCUITS AND FEEDERS

A. All conduit systems, equipment housings, material housings, junction boxes, cabinets, motors, ducts, wireways, cable trays, light fixtures, portable equipment and all other conductive surfaces shall be solidly grounded in accordance with the California Electrical Code to form a continuous, permanent and effective grounding system.

B. Install a separate insulated green equipment grounding conductor in all conduits, including service, feeder, branch circuit, and flexible; both metallic and non-metallic. The conduit systems shall not be relied upon as the system equipment grounds. Size all equipment grounding conductors per CEC 250 unless a larger ground is indicated on the drawings.

C. All panelboards, junction boxes, pullboxes, wireways, device boxes, and equipment enclosures shall be bonded to the separate green equipment grounding conductor.

D. All building expansion joints shall be bonded.

E. Isolated ground receptacles shall have both an isolated ground conductor and a separate equipment grounding conductor.

3.4 MOTOR CIRCUITS

A. Ground motors as recommended by the VFD drive manufacturers to eliminate radio frequency interference.

3.5 SEPARATELY DERIVED SOURCES

A. All secondary neutrals for the 120/208 volt wye services of dry type transformers and UPS equipment shall be grounded to building steel. Connection shall be made with an insulated grounding electrode conductor sized according to Article 250 of the California Electrical Code. Run the insulated conductor in rigid steel conduit.

3.6 FLEXIBLE RACEWAY GROUNDING

A. Install a ground conductor inside all flexible raceways (e.g. flexible steel, liquid tight). Bond the conductor to the enclosure or ground bus in the nearest box or access on either side of
the flexible section. Size conductor as specified, indicated or required by code, whichever is larger.

3.7 SECTIONAL RACEWAY

A. Install a ground conductor in all sectional raceways with removable covers for access (e.g., plug-in strips, surface raceways systems, and wireways). Size conductor in accordance with the CEC for the largest phase conductor size installed in raceway, or as indicated. Bond all sections of the raceway to the ground conductor. Connect all receptacle ground terminals in the raceway to the ground conductor, and make other ground connections indicated. This also includes all sectional raceways installed in or on University provided furniture. All surface metal raceways shall be UL listed as an equipment grounding conductor.

3.8 GENERAL GROUNDING REQUIREMENTS

A. All ground connectors shall be bronze of the clamp type. All clamp accessories such as bolts, nuts, and washers shall also be bronze to assure a permanent corrosion-resistant assembly. Make connections easily accessible for inspection, underground or concealed in floors or walls.

B. All ground cable splices, joints, and connections to ground rods shall be made with an exothermic welding process which shall provide a weld with current-carrying capacity not less than that of the conductors welded. Soldered connections shall not be used.

C. All ground wire shall be insulated, unless otherwise indicated on the Drawings, extra flexible stranded copper cables. Grounding cables installed in earth shall be laid slack.

D. Lighting and power panelboards shall be grounded by connecting a grounding conductor to the grounding stud and to the incoming and outgoing feeder conduits grounding bushings. Each grounding-type bushing shall have the maximum ground wire accommodation available in standard manufacturer for the particular conduit size. Connection to the bushing shall be with wire of this maximum size.

E. Fire alarm and fire protection systems circuits and equipment shall be grounded in accordance with CEC article 250. A separate insulated green equipment grounding conductor shall be provided.

END OF SECTION 26 05 26
PART I - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Conduit and equipment supports.
2. Fastening hardware
3. Vibration Isolation

1.2 SUBMITTALS

A. Submit for each isolator, complete manufacturer's description including quantity loading and static deflection.

1.3 REFERENCE STANDARDS

A. American Plywood Association. (APA)
B. Underwriters Laboratories. (UL) "Building Materials Directory".

1.4 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART II - PRODUCTS

2.1 SUPPORT CHANNELS

A. Acceptable Manufacturers – Support Channels

1. Unistrut
2. Super Strut
3. Or Equal

B. Support Channel: 12-gauge galvanized or painted steel, "U" section, 1-½" square nominal in section.

C. Hardware: Manufacturer's standard as required to support equipment. Provide corrosion resistant finish.

2.2 CONDUIT SUPPORTS

A. Conduit clamps, straps, and supports shall be steel or malleable iron for all exposed individual conduit runs. Clip type hangers may be used in concealed areas on individual
conduit runs. Group mounted, exposed or concealed shall be supported by trapeze hangers constructed of formed steel channels and threaded rods.

2.3 VIBRATION ISOLATION

A. Provide vibration isolation in all supporting hardware for vibrating electrical equipment, (e.g., transformers). Isolators shall be as recommended by manufacturer to maximize their effect. Isolators shall be as manufactured by Mason OPM and Eaton B-Line OPM.

PART III - EXECUTION

3.1 INSTALLATION

A. Fasten hanger rods, conduit clamps, outlet and junction boxes to building structure using bolts, beam clamps, and spring steel clips.

B. Do not fasten supports to piping, ductwork, mechanical equipment, other conduit, or roof deck.

C. Install all support devices according to manufacturers guidelines and recommendations.

D. Do not drill through structural framing members.

E. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

F. Install freestanding electrical equipment on concrete pads four inches high and overlapping equipment footprint by two inches on all sides.

G. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch off wall, or on ¾” fire rated plywood backboards.

H. Install plywood backboards over gypsum board or directly to stud framing as indicated. Fasten to studs with self-tapping screws according to APA recommendations.

I. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls with #10 S.M.S. at 12” o.c., 4 minimum, typical unless otherwise noted.

J. Do not support equipment or fixtures from the roof deck. Provide necessary framing and joist hangers to span between structural members to locate hangers properly.

K. Do not exceed a maximum point load of 100 lbs. to any member. Locate point loads at least 4’ from any other point load on the same member.

L. All equipment shall be installed in full compliance with all applicable seismic requirements of Title 24, Part 2, CBC.

END OF SECTION 26 05 29
PART 1 - GENERAL

1.1 DESCRIPTION

A. This section covers the complete interior and exterior raceway system.

B. Definition: The term conduit, as used in this Specification, shall mean any or all of the raceway types specified.

1.2 QUALITY ASSURANCE

A. Referenced Industry Standard: The following specifications and standards are incorporated into and become a part of this Specification by reference.

1. Underwriters' Laboratories, Inc. (UL) Publications:
   a. No. 1  Flexible Metal Electrical Conduit
   b. No. 1242  Rigid Galvanized Conduit
   c. No. 467  Electrical Grounding and Bonding
   d. No. 651  Rigid Nonmetallic Electrical Conduit
   e. No. 797  Electrical Metallic Tubing
   f. No. 1242  Intermediate Metal Conduit

   a. C-80.1  Rigid Galvanized Conduit
   b. C-80.3  Electrical Metallic Tubing

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable.

1. Metallic Conduit Fittings:
   a. RACO
   b. Steel City
   c. Thomas and Betts

2. Support Channel:
   a. Powers
   b. Unistrut
3. Non-Metallic Conduit and Fittings:
   a. Carlon
   b. Thomas and Betts
   c. Or equal

4. Fiberglass Reinforced Epoxy Conduit Systems:
   a. FRE Conduit, Inc.
   b. United Fiberglass
   c. Or equal

C. Coordination
   1. Coordinate conduit installation with electrical equipment furnished.
   2. Coordinate conduit installation with contract documents. Adjust installation to eliminate conflicts. Review all field conditions, and shop drawings submitted under this and other sections to insure coordination with all equipment requiring electrical service and to avoid conflict interferences. Coordinate installation sequence to avoid conflicts including equipment access and provide the fastest overall installation schedule.

1.3 STORAGE AND HANDLING
   A. Refer to the Basic Electrical Requirements section of the specifications for storage and handling requirements.
   B. Non-metallic conduits stored on-site prior to installation shall be stored on a surface off of the ground and shall be protected from the direct rays of the sun and from debris.
   C. Damaged, oxidized, warped, improperly stored material or material with excessive amounts of foreign debris will be removed from the project and replaced with new materials, at no cost to the University.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS REQUIREMENTS
   A. Furnish all materials specified herein.
   B. All conduit and fittings shall be listed and bear a label by Underwriters’ Laboratories (UL) for use as raceway system for electrical conductors.
   C. Raceway is required for all wiring, unless specifically indicated or specified otherwise.
   D. Size: The minimum size of conduit shall be ¾". The size of all conduits shall be in accordance with the CEC, but, not less than indicated on the drawings.
E. Bushings shall be metallic insulated type. Weatherproof or dust-tight installations shall be liquid-tight with sealing ring and insulated throat. Bushing shall be OZ/Gedney type KR, or equal (Or equal, no known equal.)

F. Expansion and deflection fittings shall be OZ/Gedney, type DX, or equal

G. All under floor/ground raceways will be cleaned and mandrilled before wire is installed.

2.2 EMT CONDUIT AND FITTINGS

A. Electrical Metallic Tubing shall conform to UL 797, cold rolled steel tubing with zinc coating on outside and protective enamel coating on inside.

B. Electrical Metallic Tubing (EMT) couplings and connectors shall be steel compression "concretetight" type. Malleable iron, die cast or pressure cast fittings are not permitted. All connectors shall be nylon insulated throat type. Fittings shall meet same requirements for finish and material as EMT conduit. Box connectors shall be equipped with insulated throat.

C. Connectors at cabinets, boxes, and gutters shall be metallic nylon grounding type with insulated bushings.

2.3 RIGID AND IMC CONDUIT AND FITTINGS

A. Intermediate metallic conduit and rigid steel conduit shall conform to UL 6, standard weight, mild steel pipe, zinc coated on both inside and outside by a hot dipping or sherardizing process. Inside and outside of conduit shall be finished with a protective coating.

B. Fittings for rigid steel and IMC shall be standard threaded couplings, locknuts, bushings and elbows. Fittings shall be assembled with anti-corrosion, conductive anti-seize compound at joints made absolutely tight to exclude water. All materials shall be steel or malleable iron only. Set screw or non-thread fittings are not permitted.

C. Bushings shall be metallic insulating type consisting of insulating insert molded or locked into the metallic body of the fittings.

D. Erickson-type couplings may be used to complete a conduit run. IMC couplings may be the integral retractable (Uni-Couple) type.

E. Connectors at cabinets, boxes, and gutters shall be metallic nylon grounding type with insulated bushings.

2.4 NON-METALLIC CONDUIT AND FITTINGS

A. Non-metallic conduit shall be heavy wall, Schedule 40 PVC or Schedule 80 PVC.

B. Non-metallic conduit fittings shall be of the same material as the conduit furnished and be the product of the same manufacturer. PVC 90 degree bends shall not be used. Wrapped rigid will be used in its place. Double lap of Calpico 10 mil or approved equal.

C. Maximum length of non-metallic conduit shall be twenty feet. Mark each length clearly and durably with nominal trade size, type of material, and UL label.

D. Material shall have tensile strength of 7,000 psi at 73.4°F, flexural strength of 11,000 psi and compression strength of 8,600 psi.
E. Non-metallic conduit shall be suitable for direct burial without concrete encasement.

F. All joints shall be solvent welded, 1” minimum size unless indicated on drawing.

G. All underground or underfloor conduit shall be cleaned and mandrelled before wire is installed.

2.5 FIBERGLASS REINFORCED EPOXY CONDUITS

A. Rigid non-metallic fiberglass reinforced epoxy conduits (FRE) shall be composed of glass filaments encapsulated in an epoxy matrix. All FRE conduits and fittings shall be pigmented with carbon black dispersed homogeneously throughout the epoxy glass matrix for UV protection. Conduit shall be suitable for continuous operation from -40°C to +110°C.

2.6 CONDUIT SUPPORTS

A. All parts and hardware shall be zinc-coated or have equivalent corrosion protection.

B. Conduit straps shall be single hole cast metal type or two hole galvanized metal type. Conduit clamps shall be spring steel type for use with exposed structural steel.

C. Conduit support channels shall be 1.5" x 1.5" x 12 gauge galvanized (or with equivalent treatment) channel. Channel suspension shall be minimum ¼" threaded steel rods. Spring steel clips are not acceptable. Conduit straps shall be spring steel conduit straps compatible with channel. Wire or chain is not acceptable for conduit hangers. All installations shall meet applicable seismic requirements.

D. Individual conduit hangers shall be galvanized spring steel specifically designed for the purpose, sized appropriately for the conduit type and diameter, and have pre-assembled closure bolt and nut and provisions for receiving threaded hanger rod. Support with ¼" threaded steel rod for individual conduits 1.5" and smaller and ⅜" rod for individual conduits 2.0" to 4.0" maximum. All installations shall meet applicable seismic requirements.

E. Individual conduit straps on metal studs shall be spring steel and should wrap around entire face of stud securely biting into both edges and have provisions for screwing into stud. Size for conduit to be support. Tie wraps are not acceptable.

F. Support multiple conduits from metal studs using pre-assembled bar hanger assembly consisting of hanger bar, retaining clips and conduit straps.

G. Refer to Section 16190 of these specifications for additional material requirements. Refer to Seismic Control for additional seismic requirements.

2.7 FLEXIBLE CONDUIT AND FITTINGS

A. Flexible conduit shall be steel metallic type, zinc coated on both inside and outside by hot dipping or sherardizing process.

B. Where specified herein, indicated on the drawings, or when used in damp or wet locations, as classified by the California Electrical Code, flexible conduit shall be liquid tight. Liquid-tight conduit shall be galvanized with extruded polyvinyl covering and with water-tight connectors.

C. All flexible conduit shall be classified as suitable for system grounding.

D. Connectors for flexible conduit shall be steel insulated throat type rated as suitable for system
ground continuity. Connectors for liquid tight flexible conduit shall be screw-in ground cone type.

E. Flexible conduit shall not be less than 3/4" trade size and in no case shall flexible conduit size be less than permitted by the California Electrical Code for the number and size of conductors to be installed herein.

F. No aluminum flexible conduit shall be used.

2.8 MISCELLANEOUS CONDUIT FITTINGS AND ACCESSORIES

A. Vinyl all weather electrical tape for corrosion protection shall be Scotch #88, Tomic #85, Permacel #295 or equal.

B. Expansion and deflection couplings shall be in accordance with UL 467 and UL 514. They shall accommodate 3/4" deflection, expansion, or contraction in any direction and shall allow 30 degree angular deflections. Couplings shall contain an internal flexible metal braid to maintain raceway system ground continuity. Refer to section 26 05 48 Seismic Control-OSHPD.

C. Fire and smoke stop materials shall be UL rated to maintain the fire floor or fire wall partition rating. Refer to section 07 84 00 Firestopping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Conceal all conduits, except in unfinished spaces such as equipment rooms or where indicated by symbol on the drawings or as approved by the University's Representative. Run concealed in areas having finished ceilings and furred walls. Run all cross conduits and vertical risers or drops concealed in wall and/or partitions. Run vertical risers or drops up or down between wall studs. Should it be necessary to notch any framing members, notch only at locations in a location and manner approved by University's Representative.

2. Exposed conduit below 8'-0" shall be rigid type.

3. Provide flexible connections of short length to equipment subject to vibration or movement and to all motors. Provide a separate bonding conductor in all flexible connections.

4. Support conduits per seismic guidelines outlined in section 26 05 48 and per section 26 05 29.

5. Maintain a minimum of 6" clearance from conduit to steam or hot water pipes.

6. Leave all empty conduits with a galvanized pull wire or nylon pull rope.

7. Install as complete raceway runs prior to installation of cables or wires.

8. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.
9. Secure rigid conduit i.e., rigid galvanized conduit and intermediate metal conduit, to sheet metal enclosures with two (2) locknuts and insulated bushing. Secure EMT to sheet metal enclosures with insulated throat connectors.

10. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on steel. Nails are not acceptable.

11. Protect conduits against dirt, plaster, and foreign debris with conduit plugs. Plugs shall remain in place until all masonry is complete. Protect conduit stud-ups during construction from damage; any damaged conduits shall not be used.

12. Seal all conduits originating from outside building from below grade, all conduits entering refrigerated spaces, i.e., freezers and coolers, and all conduits entering exterior mounted electrical equipment with insulating electrical putty to prevent entrance of moisture. Waterproofing material shall not contain creosote or polysulfides which are not compatible with the waterproofing system.

13. Install conduit with wiring, including homeruns as indicated on the drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by University's Representative by written authorization.

14. Where conduit passes through finished walls or ceilings, provide steel escutcheon chrome plates or paint as directed.

15. Provide sleeves for conduit passing through floor slabs and/or concrete masonry walls.

16. Conduits which penetrate roof membranes shall be installed in accordance with manufacturer's recommendations and architectural specifications.

17. Separate raceway systems are to be installed for power systems and for control, signal and communications systems. Do not install control, signal or communications cables in the same raceways as branch circuit or feeder cables, unless indicated otherwise on the drawings.

18. Provide expansion fitting in all conduits where length of run exceeds 200 feet or where conduits pass building expansion joints.

19. Telephone, data, and all service entrance conduits shall be installed with wide sweep 90° bends; minimum radius shall be 60”.

B. Uses Permitted

1. Galvanized rigid conduit or IMC shall be used as follows:
   
a. For primary and secondary service (except when installed below the ground floor slab and above the building mat slab) and for secondary unit substations, switchboard, motor control center, dry-type transformer and panelboard feeders.

b. Buried in or in contact with earth to be half-lapped with omic pipe wrapping tape with sealant applied to all joints.
c. In poured concrete walls, floor and roof construction, provided a minimum of 2" of cover is maintained.

d. In all walls up to the first outlet box where fed from rigid conduit in damp locations or locations exposed to the weather.

e. In exposed locations below 8 feet above the floor, including all mechanical rooms.

f. All elbows for underground plastic conduit.

g. All conduits for interior wiring systems whose voltage is above 600 volts.

h. All conduits entering refrigerated spaces.

i. Elsewhere where indicated on the drawings.

j. For emergency branch feeders and circuits installed outside of building.

2. Electrical metallic tubing (EMT) shall be used as follows:

a. Concealed in stud partitions and hollow masonry walls.

b. For connections from junction box to lighting fixtures except in accessible ceilings.

c. In suspended or accessible ceilings above 8 feet.

d. Exposed in dry locations above 8 feet where not subjected to mechanical damage.

e. In furred ceiling spaces.

3. Rigid non-metallic conduit shall be used as follows:

a. For the branch circuit wiring for exterior lighting pole bases and bollards (horizontal runs only).

b. All elbows, both vertical and horizontal, shall be GRC.

c. Any non-metallic PVC conduit used for emergency power systems shall be schedule 80 PVC.

d. The communications conduit shall be schedule 40 PVC.

4. All other conduit, unless excluded herein, not permitted in accordance with the California Electrical Code, or otherwise indicated on the drawings, shall be electrical metallic tubing (EMT).

5. Conduit types shall not be mixed indiscriminately with other types in the same run, unless specified herein or required by the CEC.

6. Use flexible conduit for connections to motors, dry type transformers, electrical duct heaters, unit heaters, and flush mounted lighting fixtures. Conduit must be secured. Flexible conduit shall only be used as follows:
a. Flexible conduit used for connection of motor, dry type transformers, electric duct heaters, and unit heaters, shall not exceed 18” in length.

b. Flexible conduit from outlet box to flush mounted lighting fixture shall not exceed 6 feet in length.

c. Maintain ground continuity through flexible conduit with green equipment grounding conductor; do not use flexible conduit for ground continuity.

d. Liquid tight conduit shall be used to connect equipment in mechanical equipment rooms and exterior installations, and for final connections to all equipment containing water or other liquid service.

7. Service entrance conduits shall be installed "outside" of the building as defined by the CEC. Provide concrete encasement where required.

8. No conduit requiring cutting of cross-webs of concrete masonry units is permitted. Conduit shall be threaded through cells or concrete masonry units lowered around conduit. Neither horizontal joint reinforcement nor bond beam reinforcement shall be cut for conduit installation.

9. Where hazardous locations, as classified by the California Electrical Code, exist, all conduits and fittings and the installation of these materials shall comply with Article 500 of the California Electrical Code.

10. LB condulets for conduits larger than 1-½” I.D. shall not be used unless of the mogul design and secured to the building structure within 6” below and along the side of the condulet.

C. Below Grade Raceway Installations

1. Direct Burial Conduit

a. Unless otherwise indicated install top of conduits 24” minimum below finished grade. Maximum depth shall be 36”. Utility primary conduit shall be 48” below finished grade. All conduits not under building slabs or parking lots shall be encased in a minimum of 3” concrete. All concrete for primary conduit shall contain a red pigment dye to make it readily noticeable. Provide 10% red oxide per cubic yard of material.

b. Install top of conduits 6” minimum below bottom of building slabs.

c. Install top of conduits 30” minimum below grade, below roads and any other paved surfaces.

d. Place a 4” wide, bright red, non-biodegradable plastic tape 12” above all underground conduit outside of building foundation.

e. Where transition is made from below grade PVC installation to a metallic conduit system above grade or slab, and at transition at manholes and service switchgear, make transition with rigid galvanized elbow and extend through slab or above grade with galvanized rigid steel conduit. For corrosion protection, where the elbow penetrates surface, wrap with vinyl all-weather electrical tape or coat with bituminous asphaltic compound, for 6” above and below concrete surface.
f. For excavation and backfilling, refer to Section 26 00 10 and Division 31 of these specifications.

g. Conduit shall be run following the most direct route between points and the route shall be coordinated with other disciplines.

h. All open conduit ends shall be plugged during construction to prevent water, mud, concrete and debris from entering. Prior to the installation of cables, each conduit shall be cleaned by pulling a standard, flexible mandrel not less than 12" long, with diameter approximately ¼" less than inside diameter of conduit, through the conduit. In addition, a brush with soft bristles and diameter approximately equal to inside diameter of conduit shall be pulled through conduit.

i. For all underground runs of two or more conduits, separators or spacing blocks made of plastic or other suitable nonmetallic, nondecaying material shall be placed on not greater than four foot centers. They shall be of the interlocking type both horizontally and vertically. Ducts shall be anchored to prevent movement during placement of concrete.

j. Before installing the last 8" of lift of backfill for all primary feeders and for secondary service feeders, install red, detectable underground electrical warning tape warning of buried electrical lines the full length of duct bank trench.

D. Raceway Installations Within Concrete

1. Conduit can only be installed within concrete where shown on the drawings or with the agreement of the Structural Engineer of Record

2. Conduit shall be run following the most direct route between points.

3. Conduit shall not be installed in concrete which is less than 3" thick or where the outside diameter is larger than \( \frac{1}{2} \) of the slab thickness.

4. Conduits installed in concrete slabs shall be buried in the concrete slab. Wire low conduits to upper side of the bottom reinforcing steel, and upper conduits to the lower side of the top reinforcing steel. Separate parallel runs of conduits within slab by at least 1".

5. Conduits shall not be installed within shear walls unless specifically indicated on the drawings. Conduits shall not be run directly below and parallel with load bearing walls.

6. Protect each metallic conduit installed in concrete slab or conduits 1.5" and smaller passing through a concrete slab against corrosion where conduit enters and leaves concrete by wrapping conduit with vinyl all-weather electrical tape.

7. Conduit stub-up penetrations through slabs shall be installed with the top of a threaded conduit coupling flush with the finished slab.

8. Protect all conduits entering and leaving concrete floor slabs from physical damage during construction.

9. Install all conduits penetrating rated fire floors to maintain the fire and thermal rating of the floor penetrated per section 07 84 00 Firestopping.
E. Concealed (Above Ceilings and in Walls) and Exposed Raceway Installation

1. Conduit shall be run parallel or at right angles to walls, ceilings, and structural members.

2. Support branch circuit conduits at intervals not exceeding 10 ft. and within three feet of each outlet, junction box, cabinet or fitting. Attach individual branch circuit conduits to structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hangar rod and conduit clamp assembly. Multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.

3. Attach feeder conduits larger than 1” trade diameter to or from structure on intervals not exceeding 10 ft. with conduit beam clamps, conduit straps or trapeze type support in accordance with support systems described for branch circuit conduits.

4. Single-flange clamps are unacceptable

5. Exposed conduits shall be painted, see Division 09 of the specifications.

6. For fire alarms system conduit. Paint red 6” wide every eight feet.

7. Install conduit sleeves in slabs where conduits 2.0” and larger pass through. Sleeves shall extend 1” minimum above finished slab. Seal all spare sleeves and between conduits and sleeves to maintain fire rating and to make watertight and smoketight per section 07 84 00 Firestopping.

8. Install all conduits or sleeves penetrating rated fire walls or fire floors to maintain fire rating of wall or floor per section 07 84 00 Firestopping.

9. Conduits rigidly secured to building construction on opposite sides of a building expansion joint shall be provided with an expansion and deflection coupling. In lieu of an expansion coupling, conduits 2½” and smaller may be provided with junction boxes on both sides of the expansion joint connected by 15” of slack flexible conduit with bonding jumper.

3.2 ADJUSTMENT, CLEANING AND PROTECTION

A. Clean: Upon completion, clean all installed materials of paint, dirt, and construction debris. All conduit systems shall be cleaned of water and debris prior to the installation of any conductors.

END OF SECTION 26 05 33
PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Interior Pull and Junction Boxes
      2. Exterior Pull and Junction Boxes.

1.2 SUBMITTALS
   A. None Required.

1.3 REFERENCES
   A. Underwriters Laboratories (UL)
   B. National Electrical Manufacturers Association (NEMA) #250 - Enclosures for Electrical Equipment (1000 volts maximum).

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
   A. Hoffman
   B. O.Z. Gedney; General Signal
   C. Emcor; Crenlo, Inc.
   D. Cooper B-Line
   E. or equal

2.2 PULLBOXES AND JUNCTION BOXES
   A. Indoor general purpose boxes shall be a NEMA 1 enclosure, constructed of code gauge galvanized steel. The boxes shall be constructed from a single piece of steel with folded and welded corners. The boxes shall have a flat removable, galvanized sheet metal cover held in place with binder head sheet metal screws. Supply boxes with no knockouts.

   B. Outdoor boxes shall be cast iron with a plain cast iron cover. Covers shall be neoprene gasketed and shall be NEMA 4 watertight construction. The cover shall be held in place by stainless steel screws. The cart wash and waste management areas shall be considered outdoor locations.

   C. Size boxes by code requirements related to the number and size of conduits and wire entering the box.
D. Boxes recessed in earth or concrete, use an outside flanged recessed cover box. Outdoor boxes mounted on surface, use an unflanged box.

E. Conduit openings shall be bossed, drilled and tapped in outdoor boxes.

F. Standard size metal boxes stamped from galvanized steel shall be used for indoor general purpose where size and capacity are acceptable by code.

G. Boxes shall be of the depth required for wiring capacity. Boxes shall be cast iron with threaded hubs for vaportight and wet locations.

H. Boxes for hazardous (classified) locations shall be approved for the classification and use.

I. Provide boxes with a blank cover.

J. Underground pull-boxes shall be high density reinforced concrete with end and side knockouts. All pull-boxes shall be back filled with concrete. Each pull-box shall be equipped with the following reinforced concrete accessory:
   1. 10” extension
   2. Slab
   3. Lid with hold down bolts and labeled with usage. (Steel checker plate with hold down bolts in traffic areas.)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pull boxes and junction boxes required are not shown on the plans; however, they shall be provided to meet Code requirements and improve ease of wire pulling. Provide pull boxes or junction boxes in conduit runs over 90’ long or when more than 4 quarter bends occur in a conduit run. Boxes shall be sized to meet CEC requirements.
   1. Pull boxes for communication or security cable shall be provided for runs over 90’ or when the run contains the equivalent of more than two 90° turns in any dimensional plane. See details for proper orientation and sizing of the pullbox

B. Mount all pullboxes and junction boxes securely to the building structure. Boxes shall not depend on conduit for support.

C. Install pullboxes and junction boxes such that covers are accessible. Do not install in finished areas unless approved by University’s Representative.

D. Cut or sheared edges shall be filed or honed, eliminating all sharp edges.

E. Pullboxes and junction boxes shall be installed with unused or open knockouts plugged.

F. Install pullboxes direct buried in earth or concrete flush with surface, square with surrounding structures.

G. All junction boxes shall be labeled on cover indicating circuit number and panel number and all wires shall be labeled in junction boxes with circuit numbers.
H. Splicing shall not occur in pullboxes or junction boxes.

END OF SECTION 26 05 34
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for concrete-encased duct banks, and in single duct runs.
2. Handholes and boxes.

1.3 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Duct-bank materials, including separators and miscellaneous components.
2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Accessories for manholes, handholes, boxes, and other utility structures.
4. Warning tape.

B. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Cover design.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 INFORMATIONAL SUBMITTALS

A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
2. Drawings shall be signed and sealed by a qualified professional engineer.

B. Qualification Data: For professional engineer and testing agency.

C. Source quality-control test reports.

D. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.8 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

PART 2 - PRODUCTS

2.1 CONDUIT

B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ARNCO Corp.
2. CertainTeed Corp.; Pipe & Plastics Group.
4. Electri-Flex Company.
5. Lamson & Sessions; Carlon Electrical Products.
6. Spiraduct/AFC Cable Systems, Inc.

B. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Christy Concrete Products.
2. Riverton Concrete Products; a division of Cretex Companies, Inc.
3. Utility Concrete Products, LLC.
5. Wausau Tile, Inc.

B. Comply with ASTM C 858 for design and manufacturing processes.

C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
3. Cover Legend: Molded lettering, "ELECTRIC."
4. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
a. Extension shall provide increased depth of 12 inches (300 mm).
   b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.

6. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
   a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
   b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
   c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

7. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
   a. Type and size shall match fittings to duct or conduit to be terminated.
   b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.

8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.
   2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
   3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
   4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   5. Cover Legend: Molded lettering, "ELECTRIC."
   7. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
C. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Armorcast Products Company.
   b. Carson Industries LLC.
   c. CDR Systems Corporation.
   d. NewBasis.

D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of polymer concrete.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Carson Industries LLC.
   b. Christy Concrete Products.
   c. Nordic Fiberglass, Inc.

2.5 PRECAST MANHOLEs

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Christy Concrete Products.
   2. Riverton Concrete Products; a division of Cretex Companies, Inc.
   3. Utility Concrete Products, LLC.
   5. Wausau Tile, Inc.

B. Comply with ASTM C 858, with structural design loading as required for location of manhole and with interlocking mating sections, complete with accessories, hardware, and features.

1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.

   a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.

c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

   a. Type and size shall match fittings to duct or conduit to be terminated.

   b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

C. Concrete Knockout Panels: 1-1/2 to 2 inches (38 to 50 mm) thick, for future conduit entrance and sleeve for ground rod.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.6 UTILITY STRUCTURES AND ACCESSORIES

A. All vaults, manholes, handholes, raceways, pads and other surface and subsurface structures that will be installed for the use of Southern California Edison (SCE) to provide electrical service to the project shall comply with all requirements of SCE Transmission and Distribution Business Unit (TBDU), and shall be submitted for their approval prior to installation. The installation shall be inspected and approved by SCE TBDU before the work is accepted for payment.

B. The contractor shall be thoroughly familiar with all SCE standards, installation drawings, details, requirements and procedures before proceeding with the work.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables over 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank.

B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

C. Ducts for Electrical Branch Circuits for lighting and general use power: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

D. Underground Ducts for Control, Communications, or Data Circuits: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

E. Underground Ducts Crossing Roadways: RNC, NEMA Type EPC-40-PVC, encased in steel reinforced concrete.
3.2 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less, Including Control, Communications, and Data Wiring:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-10 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.

B. Manholes: Precast concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.3 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated.

C. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.4 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1220 mm), both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

F. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in ducts, including spares.

G. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
   a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
   b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they pass under roadways. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 4 inches (100 mm) between ducts and exterior envelope wall. Minimum spacing between power conduits shall be determined by duct bank heat load calculations. Submit calculations to Engineer for approval.
7. Depth: Install top of duct bank for medium voltage conduits at least 48 inches (1,200 mm) below finished grade. Install top of duct bank for 600v and below at least 24 inches (600 mm) in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.

8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.

9. Warning Tape: Bury red, detectable underground electrical warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

H. Direct-Buried Conduit Runs:

1. Excavate trench bottom to provide firm and uniform support for conduit runs. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Division 31 Section "Earth Moving."

3. After installing conduits, backfill and compact to 4 inches (100 mm) over conduits and hand tamp. Firmly tamp backfill around conduits to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

4. Install conduits with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.

5. Depth: Install top of conduits at least 36 inches (900 mm) below finished grade, unless otherwise indicated.

6. Install manufactured conduit elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated.

7. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.

2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.

3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:
1. Manhole Roof: Install with rooftop at least 15 inches (380 mm) below finished grade.
2. Manhole Frame: In paved areas and traffic ways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
3. Handhole Covers: In paved areas and traffic ways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
4. Where indicated, cast handhole cover frame integrally with handhole structure.

C. Drainage: Install drains in bottom of manholes.

D. Manhole Access: Circular opening in manhole roof; sized to match cover size.
   1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
   2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

E. Damp proofing: Apply damp proofing to exterior surfaces of manholes after concrete has cured at least three days. Damp proofing materials and installation are specified in Division 07 Section "Bituminous Damp proofing." After ducts have been connected and grouted, and before backfilling, damp proof joints and connections and touch up abrasions and scars. Damp proof exterior of manhole chimneys after mortar has cured at least three days.

F. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

G. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

H. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (98 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

I. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
C. Elevation: In paved areas and traffic ways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

E. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

F. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.7 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 05 43
SECTION 26 05 48
SEISMIC CONTROL – OSHPD

PART 1 - GENERAL

1.1 DESCRIPTION
A. Provide all required seismic restraints and calculations in order to insure that the installation is in compliance with all applicable seismic codes and guidelines. These provisions shall be in addition to any specific information listed herein.

1.2 QUALITY ASSURANCE
A. NUSIG/Badger Industries Guidelines for seismic restraints of Electrical systems.
B. ASTM standards.

1.3 SUBMITTALS
A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of material listed in this Section.
B. Maintenance Data: Submit maintenance data and replacement material lists for each type of material listed in this section. Include this data and product data in maintenance manual.

PART 2 - PRODUCTS

2.1 SEISMIC RESTRAINT REQUIREMENTS
A. SUMMARY
1. This section covers the seismic restraint requirements for suspended vibration and non-vibration isolated items, systems and/or related suspended equipment.
2. The designers of record as called out within this specification shall be the project architect, structural engineer and the appropriate system engineer (e.g., electrical, etc.).
3. OSHPD Preapproval of Manufacturer certification OPM-0043-13 shall be considered the specified seismic design for this project. Other OSHPD pre-approved designs may be submitted as an alternate provided they meet or exceed all of the requirements contained within these specifications, and provided they meet or exceed all of the Mason Industries OPM installation applications. Alternate OPM designs must be submitted to the designers of record for review and acceptance, and to OSHPD as a deferred approval prior to installation, with all costs including but not limited to project delay costs, to be borne by the contractor.

B. SEISMIC RESTRAINT DESIGN
1. The anchorage, supports and seismic restraints of suspended systems listed below shall be designed to resist the total design seismic forces prescribed in the California Building Code (CBC).
a. All equipment including but not limited to: light fixtures, switch boards and automatic transfer switches.

b. All conduits, bus ducts and cable trays, baskets, channels including but not limited to: lighting, communication, power.

c. All electrical attached to metal suspension systems for acoustical tile and lay-in panel ceilings including but not limited to: light fixtures.

d. Without referencing OPM or OSHPD approved seismic attachment and supports shown on the design document, seismic support and attachment shall be engineered and built by the applicable system contractor. Engineering shall be (signed & sealed) by a licensed California Structural Engineer and submitted to the designers of record and OSHPD for acceptance prior to installation. Cost to be born by the contractor.

2. Seismic restraint transverse and/or longitudinal spacing shall not exceed the lesser of the following;

a. That which develops seismic design forces equal to or less than the capacity of the building structure.

b. That which develops seismic design forces that are equal to or less than the capacity of weakest part, component, anchorage, etc., contained within the seismic brace assembly.

c. 40’ feet transversely and/or 80’ feet longitudinally where pipes, conduits, and their connections are constructed of ductile materials (copper, ductile iron, steel or aluminum and brazed, welded or screwed connections).

d. 20’ feet transversely and/or 40’ feet longitudinally where pipes, conduits, and their connections are constructed of nonductile materials (e.g., cast iron, no-hub pipe and plastic).

c. 20’ feet transversely and/or 40’ feet longitudinally for bus ducts and cable trays, baskets, channels.

3. Contractor shall not adopt, use or otherwise implement the omission of any seismic restraints without prior review and acceptance by the designers of record. Submittals for omission of seismic restraints shall be limited to piping, ducts and conduits. All submittals for omission of seismic restraints must included the following, and must be (signed & sealed) by a licensed California Structural Engineer;

a. Project specific cover letter clearly indicating that said engineer has (with respect to the attached submittal for omission of seismic restraints) completely review the project documents including these specifications, the items/systems designs individually and in coordination with all other trades, and that all code and/or project specified requirements for omission of restraints have been meet individually and in combination with each other, that (if the attached submittal for omission is approved) said engineer has been hired/retained by contractor to visit the project site without limit to review and inspect the installation of the items/systems which have been reviewed and approved for installation without seismic restraints.
b. Engineered details and engineering for all vertical supports and their connections to the building structure to qualify, that top connections can not develop moments, that lateral motion will not cause loss of item/system support, that lateral motion of the item/system will not cause damaging impact with other items/systems, that lateral motion of the item/system will not directly or indirectly impact any life safety, emergency services and/or hazardous items/systems or their supports.

4. Seismic hardware brackets shall provide a (Captive) 360-degree connection that completely encloses or encircles the rod, anchor, bolt, fastener, etc. Open hook and/or open slot seismic hardware brackets shall not be allowed.

5. Seismic restraint assembly connections shall not incorporate the use of break-off bolts or nuts.

6. Seismic restraint cables shall be looped through the seismic hardware bracket and turned back onto itself at the point of assembly/connection. Cables shall not be installed or attached to the seismic hardware bracket in a straight through (non turn back) method of assembly/connection.

7. Seismic hardware brackets, connectors and related components shall be constructed entirely of malleable iron or steel. Seismic assemblies shall not include the use of cast components.

8. Ceiling and other types of single strand wire shall not be used as a seismic restraint, sway brace and/or safety restraint material.

9. The connection to the building structure of non-seismic sway bracing and/or safety restraints shall meet or exceed that required for the attachment of seismic restraints to the building structure.

10. Seismic restraints shall be installed to provide a minimum of (2) transverse and (1) longitudinal braces per run. A “run” shall be defined as a length of 5’ feet or more.

11. The accumulated load of multiple items to any given support (with or without seismic restraints) shall be limited so as not to overload the building structure and the support assembly.

12. Trapeze systems installed in a multi-layer configuration shall have seismic restraints designed and installed for each individual trapeze layer.

13. Vertical supports shall be designed and installed to account for vertical tension and compression loads including accumulated seismic component increases.

14. Vertical supports, single hanger, trapeze hangers and their clamps, clips and methods of connection shall be constructed of ductile materials (e.g., copper, ductile iron, or steel).

15. Do not use insulation inserts (e.g., cal-sil, metal, etc.) at seismic brace connection locations without prior written approval from the system design engineer. Do not connect seismic bracing to insulation inserts without prior written approval from the system design engineer.

16. Supports, seismic restraints and anchorage to the structure of all conditions that involve thermal and/or building expansion and contraction shall be engineered and built by the applicable system contractor. When applicable NUSIG / Badger
Industries OSHPD OPA-0215, pre-approved seismic bracing and anchorage details are to be used. Engineering shall be (signed & sealed) by a licensed California Structural Engineer and submitted to the designers of record for review and acceptance prior to installation. Cost of engineered adaptations and alterations borne under this section by Contractor.

17. Use following criteria for seismic bracing of electrical conduits:

a. Wherever combined weights of multiple conduits plus contents on a trapeze equals or exceeds the weight of a single 2-½” conduit plus contents, brace trapeze system in accord with NUSIG/Badger Industries.

18. The following conduit plus contents weight data may be used for EMT in lieu of page 9 of SMACNA guidelines:

<table>
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<th>EMT SIZE (IN)</th>
<th>LBS/FT</th>
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<tbody>
<tr>
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<td>0.53</td>
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<tr>
<td>¾</td>
<td>0.88</td>
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<tr>
<td>1</td>
<td>1.30</td>
</tr>
<tr>
<td>1–⅛</td>
<td>1.90</td>
</tr>
<tr>
<td>1–½</td>
<td>2.70</td>
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</tr>
<tr>
<td>2–⅛</td>
<td>5.70</td>
</tr>
<tr>
<td>3</td>
<td>9.40</td>
</tr>
<tr>
<td>3–⅛</td>
<td>10.00</td>
</tr>
<tr>
<td>4</td>
<td>12.50</td>
</tr>
</tbody>
</table>

19. SMACNA guidelines for bracing schedule 34 is set up in maximum weight per trapeze support assembly. Weight per trapeze support assembly must be calculated from above table and spacing between support assemblies.

20. For assemblies carrying less than 320 LB., down to equivalent of a single 2–⅛” conduit plus contents, use 320 LB criteria or submit alternate details for approval.

21. All single conduits 2–⅛” and larger shall be braced in accord with these guidelines and SMACNA details.

22. For additional project and/or item/system specific seismic restraint requirements that may be applicable, the contractor shall contact a NUSIG / Badger Industries representative at www.BadgerIndustries.Com or www.SeismicBracing.Com

C. ACCEPTABLE MANUFACTURERS

1. NUSIG / Badger Industries.

2. Substitutions: Must be submitted to the designers or record and OSHPD as a deferred approval and are subject to review and acceptance, see Part 2.1.B.3 of this specification.

D. ANCHORS, INSERTS AND FASTENERS
1. All anchors, inserts, fasteners or connections to the structure shall be submitted to the structural engineer of record for review and acceptance prior to installation.

2. Do not use any anchor or insert in concrete or metal decking with concrete fill, which does not have a signed structurally engineered design value based on its installed application and one of the following:
   a. ICBO evaluation report
   b. OSHPD pre-approved

3. Cast-in-place inserts used in concrete or metal decking with concrete fill, shall be constructed entirely of malleable iron or steel.

4. Cast-in-place inserts that contain internal threads shall include the installation of a jam or lock nut to secure the connection of the vertical support rod to the cast-in-place insert.

5. Cast-in-place inserts that allow for horizontal adjustment shall not be allowed, unless an engineered solution is provided to assure positive captive positioning and securement of the attachment.

6. Do not use powder driven and power driven (Shoot-In) fasteners, expansion nails or internally threaded anchors in concrete or metal decking with concrete fill.

7. All anchorage (i.e. drill-in, cast-in-place, etc.) to concrete and/or concrete filled metal decking shall provide a minimum embedment depth of (8 times) the anchorage diameter.

8. All beam clamps shall be constructed of malleable iron or steel. All single flange mounted beam clamps shall include a retaining strap or J-hook and must be submitted to the project structural engineer of record of review and acceptance prior to installation.

E. FIELD QUALITY CONTROL

1. Review of seismic restraints by a NUSIG / Badger Industries representative.

2. Inspection of seismic restraints by the (IOR) Inspector Of Record, and/or (AHJ) Authority Having Jurisdiction, and/or designers of record.

3. Make all corrections recommended by the NUSIG / Badger Industries representative, the (IOR), the (AHJ) and/or designers of record.

PART 3 - EXECUTION

3.1 SEISMIC ANCHORING AND RESTRAINTS

A. Equipment anchors:

1. Anchor all equipment per details on drawings. See also requirements for vibration and isolation in the CBC.

2. Anchoring shall be in accordance with Title 24, CBC Revised.
3. Any details provided are based on design information. Design and acquire approval for anchoring of equipment which varies from design.

B. Conduit supports:

1. Conduits shall be supported and braced per section 01 45 10, section 26 05 29, and contract drawings. If not specified elsewhere, then install per ASCE 7-10 Chapter 13.

C. Lighting fixture supports:

1. Provide independent seismic support system for all lighting fixtures.

3.2 INSTALLATION OF EXPANSION ANCHORS:

A. Where permitted in other Sections of this specification, expansion anchors may be used in hardened concrete.

B. Job testing: Load test 50 percent of the expansion anchors to the listed proof test loads stated on the drawings. If any anchor fails, then test all anchors not previously tested until 20 consecutive anchors pass. Then initial testing frequency shall be resumed. Perform the load test in the presence of the Inspector of Record.
PART 1 - GENERAL

1.1 DESCRIPTION

A.

Extent of electrical identification work is as outlined by this specification.

B.

Types of electrical identification work specified in this section include the following:

1. Electrical power, control and communication conductors.

2. Operational instructions and warnings.

3. Danger signs.


5. Fire stopping

1.2 QUALITY ASSURANCE

A.

CEC Compliance: Comply with CEC as applicable to installation of identifying labels and markers for wiring and equipment.

B.

UL Compliance: Comply with applicable requirements of UL Std 969, "Marking and Labeling Systems", pertaining to electrical identification systems.

C.

ANSI Compliance: Comply with applicable requirements of ANSI Std A13.1, "Scheme for the Identification of Piping Systems".

D.

NEMA Compliance: Comply with applicable requirements of NEMA Std No's WC-1 and WC-2 pertaining to identification of power and control conductors.

1.3 SUBMITTALS

A.

Product Data: Submit manufacturer's data on electrical identification materials and products.

B.

Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A.

Manufacturers: Subject to compliance with requirements, provide electrical identification products of one of the following (for each type marker):

1. Panduit Corporation

2. Brady, W.H. Company
3. or equal

2.2 ELECTRICAL IDENTIFICATION MATERIALS

A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, provide single selection for each application.

B. Color-Coded Plastic Tape:

1. Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick by 1-½" wide.
   a. Colors: Unless otherwise indicated or required by governing regulations, provide orange tape or per NEC.

C. Cable/Conductor Identification Bands:

1. Provide manufacturer's standard vinyl-cloth self-adhesive cable/conductor markers of wrap-around type, either pre-numbered plastic coated type, or write-on type with clear plastic self-adhesive cover flap; numbered to show circuit identification.

D. Plasticized Tags:

1. Manufacturer's standard pre-printed or partially pre-printed accident-prevention and operational tags, of plasticized card stock with matte finish suitable for writing, approximately 3-¼” x 5-¾”, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording, e.g., DANGER, CAUTION, DO NOT OPERATE.

E. Self-Adhesive Plastic Signs:

1. Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208V, EXHAUST FAN, RECTIFIER.

2. Colors: Unless otherwise indicated, or required by governing regulations, provide white signs with black lettering.

3. Baked Enamel Danger Signs:

4. General: Provide manufacturer's standard DANGER signs of baked enamel finish on 20-gauge steel; of standard red, black and white graphics; 14" x 10" size except where 10" x 7" is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH.
F. Engraved Plastic-Laminate Signs:

1. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver’s standard letter style of sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

2. Thickness: ¼”, except as otherwise indicated.

3. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

2.3 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Install electrical identification products as indicated, in accordance with manufacturer’s written instructions, and requirements of CEC and OSHA.

2. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.

3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

B. Conduit Identification:

1. Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by color-coded method, apply color-coded identification on electrical conduit in manner similar to piping identification. Except as otherwise indicated, use unainted galvanized as coded color for conduit.

C. Box Identification:

1. After completion, using an indelible wide tip marker, indicate on the cover of each junction and pull box the designation of the circuits contained therein, i.e., A-1, 3, 5. Use a black marker for normal power circuits a red marker for critical circuits, an orange marker for life safety circuits, and a green marker for equipment circuits.
2. All junction and pull boxes for wiring systems above 600V shall be identified with high voltage warning labels installed every 20 linear feet in accordance with OSHA standards. All boxes shall also be painted red, see Division 09 of the specifications.

3. All junction and pull boxes for the fire alarm system shall be painted red. All raceway for the fire alarm system shall be labeled "Fire Alarm" in red letters on intervals not to exceed ten feet.

D. Cable/Conductor Identification:

1. Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work. Refer to Section 26 05 19 of these specifications for color coding requirements.

E. Operational Identification and Warnings:

1. Wherever required by OSHA or directed by the University, to ensure safe and efficient operation and maintenance of electrical systems, including prevention of misuse of electrical facilities equipment by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes. Request a meeting with the University prior to substantial completion to coordinate warning requirements.

F. Danger Signs:

1. In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations identified by the University as constituting similar dangers for persons in or about project. Request a meeting with the University prior to substantial completion to coordinate danger sign requirements.

   a. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power of voltages higher than 110-120 volts.

   b. Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent operation (by anyone) could result in significant danger to persons, or damage to or loss of property.

G. Equipment / Device / System Identification:

1. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, ½" high lettering, on 1-½" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
a. Electrical cabinets and enclosures.

b. Access panel/doors to electrical facilities.

c. Transformers.

d. Fire alarm control panel, battery cabinets, voice alarm system cabinets, and transponders.

e. Automatic transfer switches.

2. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate. Identification of flush mounted cabinets and panelboards shall be on the inside of the device.

3. Panelboards, individually mounted circuit breakers, and each breaker in the switchboards, secondary unit substations, and distribution panels shall be identified with an engraved plastic laminate sign. Plastic nameplates shall be multicolored laminated plastic with faceplate and core as scheduled. Lettering shall be engraved minimum ¼” high letters.

   a. 480/277 volt normal power equipment shall be identified with white faceplate with green core.

   b. 480/277 volt critical branch power equipment shall be identified with white faceplate with yellow core.

   c. 480/277 volt life safety branch power equipment shall be identified with white faceplate with red core.

   d. 480/277 volt equipment branch power equipment shall be identified with white faceplate with blue core.

   e. 208/120 volt normal power equipment shall be identified with green faceplate with white core.

   f. 208/120 volt critical branch power equipment shall be identified with yellow faceplate with white core.

   g. 208/120 volt life safety branch power equipment shall be identified with red faceplate with white core.

   h. 208/120 volt equipment branch power equipment shall be identified with blue faceplate with white core.

   i. Equipment identification is to indicate the following:

      1) Equipment ID abbreviation.

      2) Voltage, phase, wires and frequency.

      3) Emergency or other system.
4) Power source origination.
   Example: Panel SLGHA1
   480/277V, 3 Ø, 4 W
   Life Safety System
   Fed by EM1

j. Submit complete schedule with the shop drawings listing all nameplates and
   information contained thereon.

4. In addition to being individually identified, the locations of disconnect switches and
   other control devices mounted in and/or behind walls, ceilings, floors, and access
   panels or plates shall also be identified. The means of identification location shall
   include the device name, type, and/or use.

H. Firestopping

a. Firestopping shall be labeled at each location where installed, on each side
   of the penetrated fire barrier, and within 12 in. of the firestopping material.

b. Refer to the construction drawings for acceptable penetration details for use
   on this project.

END OF SECTION 26 05 53
SECTION 26 05 60
ELECTRICAL DEMOLITION

PART 1 GENERAL

1.1 WORK INCLUDED:

A. Electrical demolition, removal and abandonment of electrical system for buildings to be demolished.

B. Prior to electrical demolition, submit for review, a work breakdown structure (WBS) for electrical and low voltage systems demolition and new work. Refer to Section 26 00 10 for additional submittal requirements.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

A. Materials and equipment for patching and extending work: As specified in individual sections or the specifications.

PART 3 EXECUTION

3.1 EXAMINATION:

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition Drawings are based on casual field observation and existing Record Documents. Report discrepancies to Architect and the University project manager before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION:

General: Comply with Work Plan and/or ILSM procedures specified in section 01 31 00. Demolition operations shall not proceed until work plan and/or ILSM has been reviewed and accepted by University.

A. Disconnect electrical systems in walls, floors, ceilings and exterior scheduled for removal.

B. Provide temporary wiring and connections to maintain existing systems in service during construction. When Work must be performed on energized equipment or circuits, use personnel experienced in such operations.

C. Existing Electrical Service: Maintain existing system in service. Disable system only to make switchovers and connections. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
D. Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switchovers and connections. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Telephone System: Maintain existing system in service. Disable system only to make switchovers and connections. Make temporary connections to maintain service in areas adjacent to work area.

F. Existing Public Address System: Maintain existing system in service. Disable system only to make switchovers and connections. Make temporary connections to maintain service in areas adjacent to work area.

G. Service Interruptions: Coordinate with University project manager in advance prior to service interruptions.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK:

A. Demolish and extend existing electrical work under provisions of this Section.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I. Repair adjacent construction and finishes damaged during demolition and extension Work.

J. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.4 CLEANING AND REPAIR:

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
C. Luminaires: Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.

END OF SECTION 26 05 60
PART 1 - GENERAL

1.01 DESCRIPTION

A. GENERAL:

1. This section specifies that the Contractor will provide arc-flash labels for new and existing electrical power panels included in the project scope. Contractor shall submit the arc-flash labels message/content to the University for review and acceptance.

B. SCOPE:

1. The following equipment and associated devices will be included:

a. 480 volt and 208 volt switchgear, switchboards, panelboards, motor control centers, and load centers.

PART 2 - DELETED

PART 3 - EXECUTION

3.01 GENERAL

A. Arc-flash labels shall be provided according to NFPA 70E and section 26 05 73, Electrical Identification, of these specifications.

3.02 DELETED

3.03 DELETED

END OF SECTION 26 05 74
SECTION 26 09 00
CONTROLS AND INSTRUMENTATION

PART 1  GENERAL

1.1 CONDITIONS:

A. The Requirements of General Conditions and Special Conditions apply to all Work of this Section as if fully repeated herein.

1.2 WORK INCLUDED:

A. Provide all power wiring for equipment as shown and specified.

1.3 RELATED WORK SPECIFIED ELSEWHERE:

A. Temperature control conduit and wiring included under Division 23 except as otherwise specified hereinafter.

PART 2  PRODUCTS

2.1 MATERIALS:

A. As specified in Section 26 05 00; Basic Electrical Materials and Methods.

2.2 COMBINATION LOAD EQUIPMENT:

A. Provide overcurrent protection for multi-motor and combination load equipment in conformance with U.L. Requirements. Provide overcurrent protective device in accordance with manufacturer's data plate attached to equipment actually installed whether shown or not without an increase in Contract Sum.

2.3 MAINTENANCE OUTLET:

A. Provide 120V duplex receptacle outlet NEMA 5-20R configuration equipped with ground fault circuit interrupter as specified under Section 26 27 26; WIRING DEVICES, in a FS box with weatherproof gasketed cover located within twenty-five feet (25') of each HVAC equipment in accordance with California Mechanical Code Section 309.1.

PART 3  EXECUTION

3.1 SYSTEMS:

A. Provide all conduit and wiring from panelboards or branch feeders to Contractor-furnished mechanical, and Owner-furnished equipment and make connection to equipment, motors and associated control apparatus as specified in the individual Specification Sections and as shown.

3.2 POWER EQUIPMENT:

A. Installations and related installation shown will be performed as part of Work of other Sections, but include hereunder all necessary provisions for attaching and connecting Work
of this Section thereto. Starters and controllers for various motor units requiring electrical connection only, as shown, will be supplied as part of Work of other Sections, for installation and connection hereunder. Include necessary anchors, sleeves, and similar items, and directions necessary to facilitate proper installation of the entire system.

1. Check and verify size, type, and locations of all power operated devices and their related controls; coordinate with the Work of other Sections, and provide required overload protection, circuit and control conductors (except temperature controls) to each and all locations; connect as shown. Do not proceed with Work without first verifying accuracy of data and conditions.

2. Review equipment submittals prior to installation and electrical rough-in. Verify type of connections. Coordinate details of equipment connections with supplier and installer.

3.3 TEMPERATURE CONTROL CONDUIT AND WIRING:

A. Provided as part of the Work of Division 23, including all interlock wiring between motor starter and temperature control equipment.

3.4 WIRING:

A. Except for temperature control wiring, encompass correct installation of all overload protection, control wiring and adequate power supply, and proper operation of all electrical equipment associated with the mechanical and Owner-furnished equipment.

1. The responsibility for correctness of electrical connections and protective devices described hereinbefore, for operation of equipment furnished, installed or modified as part of the Work of other Sections shall be that of other Sections.

2. Before permitting operation of any equipment which is furnished, installed or modified under Work of other Sections, review all wiring connections which have an influence on equipment or Work, and verify that these connections are correct. Ensure that overload protection devices installed are of correct type, rating and setting to properly protect said equipment.

3. Provide and install branch circuits and switches. Connect every electrical load wherever shown.

B. Use conductors with insulation suitable for temperatures encountered in heat producing equipment.

C. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit in damp or wet locations.

D. Install prefinished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.

E. Provide strain relief clamps for cord connections to outlet boxes and equipment connection boxes.

F. Make wiring connections in wiring compartment of prewired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated or required.
3.5 OVERLOAD PROTECTION:

A. When not furnished as part of the Work of other Sections as part of packaged mechanical equipment units or as a separate magnetic starter, include thermal overload protection as follows:

1. For all motors one-eighth (1/8) horsepower and larger that are controlled manually except as shown.

2. For all motors one-thirtieth (1/30) horsepower and larger that are controlled automatically by means of such devices as thermostats, aquastats, time switches, pressure switches, float switches or other similar devices.

3. For all motors one-thirtieth (1/30) horsepower and larger that are controlled manually out of sight of controller or more than fifty feet (50') away.

4. Install proper thermal protection and disconnects in accordance with applicable 2010 CEC Requirements for motors.

END OF SECTION 26 09 00
PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes the following lighting control devices:
      1. Time switches.
      2. Indoor photoelectric switches.
      3. Indoor occupancy sensors.
      4. Lighting contactors.
      5. Emergency shunt relays.

1.3 DEFINITIONS
   A. LED: Light-emitting diode.
   B. PIR: Passive infrared.

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: Show installation details for occupancy and light-level sensors.
      1. Interconnection diagrams showing field-installed wiring.
   C. Field quality-control test reports.
   D. Operation and Maintenance Data: For each type of product to include in emergency,
      operation, and maintenance manuals.

1.5 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in
      NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and
      marked for intended use.

1.6 COORDINATION
   A. Coordinate layout and installation of ceiling-mounted devices with other construction that
      penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke
      detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES
   A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering
      products that may be incorporated into the Work include, but are not limited to, the following:
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Grasslin Controls Corporation; a GE Industrial Systems Company.
3. Intermatic, Inc.
5. Lightolier Controls; a Genlyte Company.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
8. Square D; Schneider Electric.
9. TORK.
10. Touch-Plate, Inc.
11. Watt Stopper (The).

D. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: SPST.
2. Contact Rating: 20-A ballast load, 120/240-V ac.
3. Program: 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.

2.2 INDOOR PHOTOELECTRIC SWITCHES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

3. Eaton Electrical Inc; Cutler-Hammer Products.
5. Intermatic, Inc.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
8. Novitas, Inc.
10. Square D; Schneider Electric.
11. TORK.
12. Touch-Plate, Inc.
13. Watt Stopper (The).

D. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit[ mounted on luminaire], to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.

3. Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lx) 100 to 1000 fc (1080 to 10 800 lx), with an adjustment for turn-on and turn-off levels within that range.

4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.

5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.3 INDOOR OCCUPANCY SENSORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Hubbell Lighting.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Novitas, Inc.
5. RAB Lighting, Inc.
6. Sensor Switch, Inc.
7. TORK.
8. Watt Stopper (The).

D. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.

4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

6. Bypass Switch: Override the on function in case of sensor failure.

7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.

E. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.

F. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).

G. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum 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).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.4 LIGHTING CONTACTORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
4. GE Industrial Systems; Total Lighting Control.
5. Grasslin Controls Corporation; a GE Industrial Systems Company.
6. Hubbell Lighting.
7. Lithonia Lighting; Acuity Lighting Group, Inc.
9. Square D; Schneider Electric.
10. TORK.
11. Touch-Plate, Inc.
12. Watt Stopper (The).

D. Description: Electrically operated and electrically held, combination type with nonfused
disconnect, 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, and high-inrush ballast (ballast with 15 percent 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.

2.5 EMERGENCY SHUNT RELAY

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering
products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the
following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product
indicated on Drawings or a comparable product by one of the following:

1. Lighting Control and Design, Inc.

D. Description: Normally closed, electrically held relay, arranged for wiring in parallel with
manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 120 V.

2.6 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12
AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power
Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not
smaller than No. 22 AWG. Comply with requirements in Division 26 Section "Low-Voltage
Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller
than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical
Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas
indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
3.2 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. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).
   B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
   C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
   D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION
   A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
      1. Identify controlled circuits in lighting contactors.
      2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
   B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL
   A. Perform the following field tests and inspections and prepare test reports:
      1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
      2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
   B. Lighting control devices that fail tests and inspections are defective work.

END OF SECTION 26 09 23
CHAPTER 26 12 19
PADMOUNTED MEDIUM-VOLTAGE TRANSFORMERS

1.01 The requirements of the Contract, Division 01, and Division 26 apply to work in this Section.

1.02 SECTION INCLUDES

A. Three-phase pad-mounted transformers with separable high voltage connectors (dead front)

1.03 RELATED SECTIONS

1.04 REFERENCES

The 3-phase, pad-mounted, dead front transformers and protection devices in this specification are designed and manufactured according to latest revision of the following standards (unless otherwise noted).

A. ANSI C57.12.26, Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High Voltage Connectors, High Voltage, 34 500 Grd Y/19 920 Volts and Below; 2500 KVA and Smaller, Requirements

B. ANSI C57.12.70, Terminals Markings and Connections for Distribution and Power Transformers

C. ANSI C119.2

D. ANSI/IEEE C57.12.00, Distribution, Power, and Regulating Transformers, General Requirements for Liquid-Immersed

E. ANSI/IEEE C57.12.80, Terminology for Power and Distribution Transformers including supplement ANSI/IEEE C57.12.80a


1.05 DEFINITIONS

1.06 SYSTEM DESCRIPTION

A. Pad-mounted, compartmental-type transformer shall consist of a transformer tank and two cable terminating compartments, one each for high and low voltage. Transformer tank and compartments shall be assembled as an integral unit for mounting on a pad.

B. There shall be no exposed screws, bolts, or other fastening devices that are externally removable. There shall be no openings through which foreign objects such as sticks, rods, or wires might contact live parts. There shall be means for padlocking compartment
door(s). Construction shall limit entry of water (except flood water) into compartment so as not to impair transformer operation.

1.07 SUBMITTALS

A. Manufacturer shall provide copies of following documents to owner for review and evaluation in accordance with general requirements of Division 01 and Division 26:

1. Product Data on specified product;
2. Shop Drawings on specified product;
3. Standard Test Data, as required by ANSI/IEEE C57.12.90, by Transformer Serial Number to follow shipment.

1.08 PROJECT RECORD DOCUMENTS

1.09 Maintain an up-to-date set of Contract documents. Note any and all revisions and deviations that are made during the course of the project.

1.10 OPERATION AND MAINTENANCE DATA

A. Manufacturer shall provide copies of installation, operation and maintenance procedures to owner in accordance with general requirements of Division 01 and Division 26.

B. Submit operation and maintenance data based on factory and field testing, operation and maintenance of specified product.

1.11 QUALITY ASSURANCE (QUALIFICATIONS)

A. Manufacturer shall have specialized in the manufacture and assembly of 3-phase pad-mounted transformers with separable insulated high voltage connectors for 30 years.

1.12 REGULATORY REQUIREMENTS

1.13 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products in accordance with recommended practices listed in manufacturer's Installation and Maintenance Manuals.

B. Deliver each transformer on individual shipping skids for ease of handling.

C. Inspect and report concealed damage to carrier within specified time.

D. Handle in accordance with manufacturer's written instructions to avoid damaging equipment, installed devices, and finish. Lift only by installed lifting eyes.

1.14 PROJECT CONDITIONS (SITE ENVIRONMENTAL CONDITIONS)

A. Follow (standards) service conditions before, during and after (product name) installation.
1.15 WARRANTY

A. Manufacturer warrants equipment to be free from defects in materials and workmanship for 1 year from date of shipment.

1.16 FIELD MEASUREMENTS

A. Make all necessary field measurements to verify that equipment shall fit in allocated space.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. General Electric Company products have been used as the basis for design. Other manufacturers’ products of equivalent quality, dimensions and operating features may be acceptable, at the Engineer’s discretion, if they comply with all requirements specified or indicated in these Contract documents.

2.02 MANUFACTURED ASSEMBLIES

2.03 Furnish three-phase pad-mounted, dead front transformers as indicated in drawings.

2.04 COMPONENTS

Refer to Drawings for: actual layout and location of equipment and components; voltage ratings and other required details.

A. Standard construction

1. Transformer ratings shall be as indicated in drawings.

   a. Three-phase
   b. Oil-immersed, self-cooled
   c. 60 Hz.
   d. 65 degree C Rise
   e. Insulating liquid shall be high firepoint Beta fluid
   f. Primary winding: Delta
   g. Secondary winding: Wye
   h. The tap changer control is for de-energized operation only and must be externally operable with a hotstick and requires at least two operator
actions to change taps. The preferable location for the control is in the primary compartment.

i. Primary taps: Two, 2 1/2 percent above and two, 2 1/2 percent below

2. Transformer shall consist of a transformer tank with high- and low-voltage cable terminating compartment. The transformer tank and compartment shall be assembled as an integral unit for mounting on a pad. There shall be no exposed screws, bolts, or other fastening devices which are externally removable. There shall be no openings through which foreign objects such as sticks, rods, or wires might contact live parts.

3. The construction shall limit the entry of water (other than flood water) into the compartment so as not to impair the operation of the transformer.

4. Full-height, air-filled incoming and outgoing terminal compartments with hinged doors and separated by a steel barrier shall be located side-by-side. Incoming compartment shall be on the left, outgoing compartment on the right.

5. High-voltage compartment shall be accessible only after door to low-voltage compartment has been opened.

6. To facilitate making connections and permit cable pulling, the doors and compartment hood shall be removable. Removable door sill on compartments shall be provided to permit rolling or skidding of unit into place over conduit studs in foundation.

7. Compartment hood shall be removable for pulling cables and making connections. Compartment door sills shall be removable to permit rolling or skidding unit into place over conduit studs in foundation.

8. Compartments hinged doors shall be equipped to latch in open position. High-voltage compartment door shall have a fastening device that is accessible only through low-voltage compartment.

9. Door hinge assemblies shall be made of corrosion-resistant material. 3/8 inch (minimum) diameter stainless-steel hinge pins shall be used.

10. Both compartment doors shall be able to be locked with a single padlock having a maximum 1/2-inch diameter shackle.

11. Provide lifting provisions in accordance with ANSI Standards, as well as jacking and rolling provisions.

12. Instruction nameplate shall be located in low-voltage portion of compartment and shall be readable with cables in place. Where the nameplate is mounted on a removable part, manufacturer’s name and transformer serial number shall be permanently affixed to a non-removable part.

13. Transformer tank shall be sealed-tank construction with a welded main cover.
14. A bolted tamper-resistant handhole shall be provided in tank cover for access to internal connections.

15. Provisions for tank grounding shall be supplied in both high- and low-voltage compartments. These provisions shall consist of:
   a. For 500 KVA and below, 1/2-13 UNC tapped hole 7/16-inch deep;
   b. For 750 KVA and above: 2, 1/2-13 UNC tapped holes 1/2-inch deep.

16. HV and LV bushings shall be externally replaceable. The inside terminal connections shall be externally removable through the connectors opening in the transformer tank or through a handhole.

17. Low voltage bushings shall be tinned, spade-type with 9/16-inch holes spaced on 1-3/4-inch centers in accordance with latest revisions of applicable ANSI standards.

18. For wye-wye connected units, high- and low-voltage neutrals shall be connected internally and brought out through a bushing in secondary compartment.

19. Unless otherwise specified, incoming primary section shall be equipped with three, 200-ampere bushing wells in accordance with ANSI C119.2.

20. Primary (separable insulated high-voltage connector) bushings:
   a. Three, 200-ampere bushing wells equipped with 200-ampere loadbreak bushings

21. Overcurrent Protection
   a. Three current-limiting fuses in LOADBREAK, dry-well fuseholders. Fuseholder shall accept general purpose, distribution current-limiting fuses with interrupting capacity of 50,000 amperes. Fuseholders shall be located in primary compartment and be hot-stick operable for external replacement of fuses. LOADBREAK fuseholder shall be able to interrupt a minimum of 100 amperes.

22. Switches
   a. Radial feed switch shall be an internal, oil-immersed, gang-operated, two-position (ON-OFF), loadbreak, manually operated switch. Switch shall be able to switch transformer full-load current. Switch handle shall be located in primary compartment and shall be hot-stick operable.

2.05 ACCESSORIES

A. Standard accessories for all units:

1. 1-inch filling provision;
2. 1-inch drain provision;

3. Liquid level indication.

4. 1-inch drain valve and sampler.

5. One-inch drain valve and sampler;

6. Dial-type thermometer;

7. Liquid-level gauge;


9. Pressure-vacuum gauge;

2.06 TESTING

A. No load loss

B. Excitation current at rated voltage

C. Polarity check

D. Ratio check

E. Low frequency dielectric tests at high and low voltage

F. Mechanical leak test

G. Load loss

H. Impedance

I. Production line impulse test

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that transformers are ready to install.

B. Verify field measurements are as instructed by manufacturer.

C. Verify that required utilities are available, in proper location and ready for use.

3.02 INSTALLATION
Additional provisions and editing may be required for this part.

A. Install per manufacturer's instructions.

3.03 ADJUSTING

A. Adjust all switches, access doors, operating handles for free mechanical and/or electrical operation as described in manufacturer's instructions.

B. Adjust primary taps so that secondary voltage is within 2 percent of rated voltage.

3.04 CLEANING

A. Clean transformers to remove construction debris, dirt, shipping materials.

B. Repaint scratched or marred exterior surfaces to match original finish.

END OF SECTION 26 12 19
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Wall Switches
2. Receptacles
3. Device Plates
4. GFI Receptacles
5. Incandescent Dimmers

1.2 SUBMITTALS

A. Shop Drawings: Submit in accordance with Division 01.
B. Provide manufacturers product specification sheets for all specified devices.
   1. Include specific color, material and finish.
   2. Include manufacturers catalog device number.
   3. Include manufacturers spec data to specifically indicate conformance with these specifications.
C. Samples: Provide device and plate samples if indicated or requested by the University's Representative.

1.3 REFERENCE STANDARDS

A. National Electrical Manufacturers Association.
   1. NEMA WD-1 - General Purpose Wiring Devices.
   2. NEMA WD-5 - Specific Purpose Wiring Devices

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Leviton
B. Pass and Seymour/Sierra
C. or equal
2.2 WALL SWITCHES

A. Type: Quiet toggle AC heavy-duty rated 20 ampere at 120/277 volt. Provide the configuration listed in the table below or as indicated.

B. Grade: Heavy duty industrial grade. Refer to reference manufacturer below.

C. Construction: Back and side wired, with silver alloy contacts and screw down wire termination clamps. Switch shall be self-grounding and include a grounding screw terminal.

D. Color: Toggles shall be ivory color finish. Switches on critical or equipment branch power shall be red. Verify color with University’s Representative prior to order.

E. Key Switch: Provide locking type switch with key where indicated. Provide key with each switch.

F. Pilot switches: Lighted handle type with red pilot illuminated when switch is in "On" position.

G. Reference Manufacturer: Leviton catalog numbers are used in the following table to identify specific switches and grade:

<table>
<thead>
<tr>
<th>Poles</th>
<th>Amps</th>
<th>Volts</th>
<th>Cat. No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>20</td>
<td>277 - AC</td>
<td>1221-2</td>
<td>Toggle-Quiet</td>
</tr>
<tr>
<td>Double</td>
<td>20</td>
<td>277 - AC</td>
<td>1222-2</td>
<td>Toggle-Quiet</td>
</tr>
<tr>
<td>Three Way</td>
<td>20</td>
<td>277 - AC</td>
<td>1223-2</td>
<td>Toggle-Quiet</td>
</tr>
<tr>
<td>Four Way</td>
<td>20</td>
<td>277 - AC</td>
<td>1224-2</td>
<td>Toggle-Quiet</td>
</tr>
<tr>
<td>SPDT</td>
<td>20</td>
<td>277 - AC</td>
<td>1257</td>
<td>Momentary Contact</td>
</tr>
<tr>
<td>Single</td>
<td>20</td>
<td>120/277 - AC</td>
<td>1221LH/7L</td>
<td>Lighted Handle</td>
</tr>
<tr>
<td>Single</td>
<td>20</td>
<td>120/277 - AC</td>
<td>1221PL/7P</td>
<td>Pilot</td>
</tr>
<tr>
<td>Single</td>
<td>20</td>
<td>277 - AC</td>
<td>1221-2L</td>
<td>Locking Type</td>
</tr>
<tr>
<td>Single</td>
<td>20</td>
<td>277 - AC</td>
<td>1221 w/cover</td>
<td>Weather Proof</td>
</tr>
</tbody>
</table>

2.3 RECEPTACLES

A. Type: Standard straight blade or locking as indicated. Convenience outlets shall be rated at 20 amperes at 125 volts, composition base with slots to accommodate parallel plug caps with grounding peg unless indicated otherwise on drawings.

B. Grade: UL listed Hospital grade wherever receptacles are indicated. Refer to reference manufacturer below.

C. Construction: Back and side wired with screw down wire termination clamps of the voltage and configuration indicated. Body constructed of thermoplastic, nylon or urea with wrap-around steel strap. Face construction of a polycarbonate or nylon. Self grounding with a grounding screw terminal.

D. Color: Face shall be ivory. Receptacles with special configurations not available in specified color shall be black. Receptacles on critical, life safety, or equipment branch power shall be red.

E. Configuration: NEMA 5-20R, unless identified on the drawings by another NEMA configuration number.

F. Isolated Ground Type: Provide only where indicated. Color of receptacle face shall match other 5-20R receptacles. Receptacle shall have orange dot isolated ground identification.
G. Reference Manufacturer: Leviton catalog numbers, unless otherwise noted are used in the following table to identify specific receptacles:

<table>
<thead>
<tr>
<th>Poles/</th>
<th>NEMA</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wires</td>
<td>Volts</td>
<td>Amps</td>
</tr>
<tr>
<td>2P-3W</td>
<td>125</td>
<td>20</td>
</tr>
<tr>
<td>2P-3W</td>
<td>125</td>
<td>20</td>
</tr>
<tr>
<td>2P-3W</td>
<td>125</td>
<td>30</td>
</tr>
<tr>
<td>2P-3W</td>
<td>250</td>
<td>20</td>
</tr>
<tr>
<td>2P-3W</td>
<td>250</td>
<td>30</td>
</tr>
<tr>
<td>2P-3W</td>
<td>125</td>
<td>20</td>
</tr>
<tr>
<td>2P-3W</td>
<td>125</td>
<td>20</td>
</tr>
</tbody>
</table>

2.4 G.F.I. RECEPTACLES

A. Type: 120 volt 20 ampere duplex feed through type.

B. Color: Face color to match other 5-20R receptacles.

C. Grade: Hospital Grade

D. Operation: Differential current sensing device capable of detecting ground fault currents of 5 milliamps, plus or minus 1 milliamp and interrupt the supply circuit within the UL trip time curve.

E. Test and Reset: Provide a test and reset button on the receptacle.

F. Exterior Installation: Install in FS box with weatherproof cover as specified.

G. All receptacles in restrooms within 6’ of sink, outdoors and at water fountains shall be ground fault interrupter type.

2.5 DEVICE PLATES

A. Scope: Switches, receptacles, telephones and all other outlets (including signal systems and blank outlet boxes) shall be covered with specified plate. All plates shall match and be of the same manufacturer.

B. Type: Smooth no-line with rounded edges and corners. Standard size.

C. Color, Material and Locations:

1. Stainless Steel: Brushed stainless steel with stainless steel screws at all locations, except as indicated below.

2. Unfinished Areas: In tunnels, above ceilings and in unfinished areas, device plates shall be galvanized steel utility type.

3. Weatherproof Outlets: Provide cast aluminum plate with a hinged backing double lift cover and gasket allowing either surface or recessed mounting. Plate shall allow horizontal mounting of a duplex receptacle with a horizontal hinge. Hubbell #5205 or equal for standard boxes or Hubbell #5206 or equal for FS boxes. GFI outlets shall be provided with an appropriate cover.

4. Clock outlets: Provide 302 stainless steel with a hanging bracket and regressed receptacle. Sierra #S3733-SS, or equal.
D. Engraving:

1. All device plates shall be engraved on the face with \( \frac{3}{4} \)" high black letters. Special purpose device plates, including fan motor controls, special voltages, sound system outlet identification, and special signal system identification, shall be engraved identifying use. Special receptacles shall be identified with voltage, amperage, and phase. All other devices, including receptacles and light switches, shall have panel number and circuit number engraved.

2. All critical and life safety branch outlet plates shall be engraved with red letters.

3. All device plates shall be of the same manufacturer.

2.6 INCANDESCENT DIMMERS

A. Acceptable Manufacturers:

1. Lutron-Nova or Nova T-Star.

2. Lightolier - Momentum.

3. Leviton - Decora

4. Or equal.

B. Type: Incandescent wall box dimmer shall be Triac type, gated control, full wave A.C. switch. The dimmer shall utilize a toroidal filter for maximum R.F. suppression. Provide dimmer rated for low voltage incandescent fixtures where required and for all dimmers controlling lighting tracks.

C. Performance: Dimmer shall operate on the square law dimming curve and shall be adjustable from 0 to full load. Dimmer shall have a positive off and linear slide control with separate ON/OFF switch. Switch shall allow lighting to be preset at a desired level then return to that level after the switch is turned OFF and ON again. The dimmers shall be able to be installed on a common neutral system without experiencing gating interference.

D. Dimmer shall have an integral heat sink with no exposed radiator fins and shall be available in sizes ranging from 600 watts to 2000 watts. Dimmers shall be sized for no more than half of its rated load as indicated on the plans.

E. Color: Face plate shall be a standard color to match the light switches in the area as specified in Part 2.2 above.
2.7 OCCUPANCY SENSORS

A. Provide occupancy sensors in the locations indicated on the documents for control of the rooms indicated. Occupancy sensors shall be Watt Stopper or equal. Provide power supplies as indicated by manufacturer to allow a fully functioning system.

B. Devices indicated on the plans shall include:
   1. Passive Infrared Occupancy Sensor
   2. Ultrasonic Occupancy Sensor
   3. Combination Passive Infrared and Ultrasonic Occupancy Sensors
   4. Daylight Sensors
   5. Dimmers
   6. Photocell

2.8 PHOTOCELLS

A. Low voltage photocells and day lighting sensors shall be provided where indicated.

B. Provide adjustable aperture with on/off delay feature to eliminate nuisance cycling.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Light Switches:
   1. Install all outlet boxes for light switches flush in wall where possible. Where more than one switch appears at the same location, they shall be installed in a ganged box with a single plate.
   2. Verify with the University's Representative the correct room numbers and terminology before engraving plates.
   3. Install all single pole switches with "on" in the up position and "off" in the down position.
   4. Mount switches at the elevation indicated on the drawings. Dimensions are to the center of the box. For masonry walls, adjust height as required to install end of device at the nearest mortar joint.

B. Receptacles:
   1. Where receptacles are shown adjacent to other devices, the boxes shall be installed with 2" between devices of other systems.
2. Mount receptacles at the elevation indicated on the drawings. Mounting heights are to the center of the outlet. For masonry walls, adjust height as required to install end of device at the nearest mortar joint.

3. Mount receptacle vertically with the grounding U at the top. For horizontally mounted receptacles mount receptacle with neutral side Up.

C. G.F.I. Receptacles:
   1. Install ground fault receptacles at all receptacle locations indicated on the plan as G.F.I.
   2. Where a number of receptacles in sequence are marked G.F.I, the first receptacle shall contain the sensing interrupting device and the remainder shall be standard receptacles served from the protected feed through connection.

D. Plates:
   1. Coordinate multiple gang plates for proper arrangement, openings and engraving.
   2. Provide blank plates mounted on the outlet box for all empty conduit systems.
   3. Plates shall match and shall be mounted square with the building structure.
   4. Provide cadmium plated cover plates for surface boxes in unfinished spaces.
   5. Secure plates to device or box with proper attachment screws.

E. Dimmers:
   1. Mount each dimmer in an individual box with ½” minimum spacing away from adjacent switches.
   2. Dimmers shall be ganged where more than one occurs at a room location. Size dimmers according to the manufacturers derating factors. Install according to manufacturers recommendations.
      a. Provide engraving where indicated to identify the specific load controlled by the dimmer.

3.2 WIRING AND CONNECTIONS

A. Terminate ground wire at device where ground wire is provided within the raceway system.

B. Carefully strip thermoplastic wire to length and make-up terminal connection as recommended by the device manufacturer.

C. Secure device to outlet box with proper screws.

3.3 TESTING AND INSPECTION

A. Test all receptacles for ground continuity and polarity.
B. Test all GFI interrupting receptacles.

C. Inspect all devices for defective operation or breakage, cracks or chips. Replace defective devices or devices damaged during construction.

D. Dimmers:
   1. Install and wire dimmer as recommended by the manufacturer. Obtain manufacturers wiring diagrams for system applications.
   2. Do not wire dimmers hot. Follow manufacturer's instructions to avoid damage to the device.
   3. Test each application to verify proper dimming and control. Correct wiring or installation where dimming of lamps is not uniform.

E. Test all devices according to code and manufacturers requirements.

END OF SECTION 26 27 26
SECTION 26 28 13
FUSES – 600 VOLTS

PART 1 - GENERAL

1.1 DESCRIPTION
A. This section includes low voltage (600 volts and below) fuses for the building power distribution systems, including motor controls, disconnect switches, and fusible panelboards as applicable.

1.2 QUALITY ASSURANCE
A. Codes and Standards: The following specifications and standards are incorporated into and become a part of this specification by reference.

1. Underwriters Laboratories, Inc. (UL) Publications:
   a. UL 198.
   b. UL 512; Fuseholders.
   c. UL Product Directory; Electrical Construction Materials.

   a. C97.1; Low Voltage Cartridge Fuses 600 Volts or Less.

3. National Electrical Manufacturers Association (NEMA):
   a. NEMA FU1; Low Voltage Cartridge Fuses.

B. Acceptable Manufacturers: Subject to compliance with requirements, provide fuses of one of the following:

1. Bussmann
2. Ferraz / Shawmut
3. or equal

1.3 SUBMITTALS
A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.

1. Product data for each fuse type. Include the following:
   a. Descriptive data and time-current curves.
   b. Let-through current curves for fuses with current limiting characteristics.
   c. Coordination charts and tables and related data.
PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise indicated, provide fuses of types, size, ratings, and average time-current and peak let-through current characteristics indicated, which comply with manufacturer's standard design, materials, and constructed in accordance with published product information, and with industry standards and configurations.

2.2 CARTRIDGE FUSES

A. Provide NEMA FU 1 non-renewable cartridge fuses as specified below.

1. Motors and Transformers Below 600 Amps: Provide UL Class RK1 time-delay fuses rated 600 volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating.

2. Other Branch Circuits: Provide UL Class RK5 non-time-delay fuses rated 600 volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating.

3. Class T Fuses: Provide UL Class T fuses rated 600 volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protection of physically small devices.

2.3 SPARE FUSE CABINET

A. Cabinet: Wall mounted, 18-gage minimum steel unit with full-length, recessed piano-hinged door key key-coded cam lock and pull.

1. Size: Adequate for orderly storage of spare fuses specified with 100% spare capacity minimum.

2. Finish: Gray baked enamel.

3. Identification: Stencil legend "SPARE FUSES" in 1-½” (40 mm) letters on door.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses in all fusible devices in accordance with manufacturers written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with CEC and NEMA standards for installation of fuses. Arrange fuses so that fuse ratings are readable without removing fuse.

B. Coordinate with other work, including electrical wiring as necessary to interface installation of fuses with other work.

C. Install fuses in fused switches, if any.

D. For types and ratings required, furnish additional fuses, amounting to one unit for every 5
installed units, but not less than one set of 3 of each kind. Install spare fuse cabinet as indicated on the drawings.

E. Prior to energization of fusible devices, test devices for continuity of circuitry and for short-circuits. Replace malfunctioning units with new units, and then demonstrate compliance with requirements. Fuses shall not be installed until equipment is ready to be energized.

F. Provide fuses of the proper voltage rating, either 250 or 600 volts, and proper class as required for each piece of equipment. Size fuses for motor protection based on the actual nameplate rating of motor - sizes indicated on drawings are for magnitude only.

3.2 IDENTIFICATION

A. Install typewritten labels on the inside door of each fused device to indicate fuse replacement information.

B. Provide written index of all required fuses and all spare fuses and include in University's Operating and Maintenance Manuals.

END OF SECTION 26 28 13
SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1  GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Receptacle switches.
   4. Shunt trip switches.
   5. Molded-case circuit breakers (MCCBs).
   7. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.
B. NO: Normally open.
C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of
   earthquake motions determined according to ASCE/SEI 7.

   1. The term "withstand" means "the unit will remain in place without separation of any parts
      from the device when subjected to the seismic forces specified and the unit will be fully
      operational after the seismic event."

1.5 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component
   indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical
   data on features, performance, electrical characteristics, ratings, accessories, and finishes.

   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current ratings (interrupting and withstand, as appropriate).
   4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control reports.
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Manufacturer's field service report.

G. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency’s Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

E. Comply with CEC.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Architect, Construction Manager and Owner no fewer than ten days in advance of proposed interruption of electric service.
   2. Indicate method of providing temporary electric service.
   3. Do not proceed with interruption of electric service without Architect’s, Construction Manager’s, and Owner’s written permission.
   4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Fuse Pullers: Two for each size and type.

PART 2 PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   4. Square D; a brand of Schneider Electric.

C. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Six Pole, Single Throw, 240-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Type HD, Heavy Duty, Double Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

G. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
   6. Hookstick Handle: Allows use of a hookstick to operate the handle.
   7. Lugs: Mechanical type, suitable for number, size, and conductor material.
   8. Service-Rated Switches: Labeled for use as service equipment.
2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   2. Siemens Energy & Automation, Inc.

C. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Six Pole, Single Throw, 240-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Type HD, Heavy Duty, Double Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

G. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
   5. Hookstick Handle: Allows use of a hookstick to operate the handle.
   6. Lugs: [Mechanical] [Compression] type, suitable for number, size, and conductor material.

2.3 RECEPTACLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
2. Siemens Energy & Automation, Inc.

C. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 240-V ac, or 100 A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: 240-V ac, or 100 A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

E. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

F. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).
   1. Receptacle Manufacturer and Catalog Number:

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   2. Siemens Energy & Automation, Inc.

C. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.


E. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

F. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
   1. Instantaneous trip.
   2. Long- and short-time pickup levels.
   3. Long- and short-time time adjustments.
   4. Ground-fault pickup level, time delay, and I^2t response.
G. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

H. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.


J. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

K. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
   4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
   5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Division 26 Section "Electrical Power Monitoring and Control."
   6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
   7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
   8. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
   9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
  10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
  11. Zone-Selective Interlocking: Integral with electronic or ground-fault trip unit; for interlocking ground-fault protection function.
  12. Electrical Operator: Provide remote control for on, off, and reset operations.

2.5 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
2. Siemens Energy & Automation, Inc.

C. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

D. Features and Accessories:
   1. Standard frame sizes and number of poles.
   2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
   3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
   4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
   5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
   6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
   7. Alarm Switch: One NO contact that operates only when switch has tripped.
   8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
   9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
   10. Electrical Operator: Provide remote control for on, off, and reset operations.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.
   3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X.
   4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
   5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls-OSHPD."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

E. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Perform the following infrared scan tests and inspections and prepare reports:
a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.

c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

END OF SECTION 26 28 16
DIVISIONS 27 – 49
NOT USED