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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-STAIR TOWER & EXIT CORRIDOR UPGRADES
B. UCDHS A/C #: 9559040
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 consists of the fabrication and installation of an 8 story stair tower affixed to the exterior of an existing structure. Included in that work is new rated Vestibules at each floor, exit pathways, demolition of exiting stairs, repairs to ramps, new 2 floor stair case, new toilet rooms, New sewage ejector pump and pump room, new Mechanical units and ducting, new electrical branch and feeders and all infection control procedures required to complete the project.

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. Sewage Ejector Pump.
2. Stair 9 and adjacent corridors and rooms.
3. 1st Floor Exit Corridor and adjacent corridors and rooms.
4. Stair 5 and adjacent corridors and rooms.

1.10 PROJECT PHASING

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

1. Phase I - Sewage Ejector pump, pump room, and demolition & temporary construction for Ground Floor Corridor 0100 / Vestibule 0102A shall be completed prior to Phase II.

2. Phase II – Balance of the project work scope.
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 for Stair #5 vestibules and rooms directly adjacent to Stair #5 Tower – Ground Floor through 8th Floor.
   b. Perform Hazmat Abatement within area of construction for Stair #9 - Ground & 1st Floor.
   c. Perform Hazmat Abatement for all corridors within the construction area at the 1st floor.
   d. 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. **Provide & maintain minimum of three (3) motorized electric carts equal to Zallys HS4 electric transporter. Carts shall be use to move materials & equipment up and down the west ramp. Motorized carts shall be highly maneuverable, and include: electromagnetic brake, non-marking tires, with maximum speed restricted to 3mph when inside, & 5mph when outside. [http://www.vehicle-electric.net/archives/150-electric-platform-truck-Zallys-mod.HS4.html#extended](http://www.vehicle-electric.net/archives/150-electric-platform-truck-Zallys-mod.HS4.html#extended)** When operating motorized carts at interior or crowded areas, provide an escort that walks in front of the motorized cart at all times.

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

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
SECTION 01 25 00
CLARIFICATION/INFORMATION PROCEDURES

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. 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. Faxed 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**

**A/C #:** 9559040  
**Project Title:** Stair Tower & Corridor Upgrades – Increment 3  
**RFI #:**  
**Date:**  
**OSHPD #:** I140010-34-03

| 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: 916-734-1375 |
| Email: dcbrooks@ucdavis.edu |

**SUBJECT:**

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

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**INFORMATION NEEDED:**

**CONTRACTOR'S PROPOSED RESOLUTION:**

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

**ATTACHMENTS:**

**REPLY:**

**REPDONER SIGNATURE:**  
**DATE:**

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**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 25 05
CONTRACT MODIFICATION PROCEDURES

PART I - GENERAL

1.01 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

1.02 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 61 00 – PRODUCT REQUIREMENTS: Product Options, substitutions, omissions and improper descriptions.
E. Section 01 77 00 – CLOSEOUT PROCEDURES: Project record documents.

1.03 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

1.04 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.

1.05 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 61 00 – PRODUCT REQUIREMENTS.
1.06 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.

1.07 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 II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION

3.01 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.

3.02 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 01 25 05
PART I - GENERAL

1.01 SECTION INCLUDES

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

1.02 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

1.03 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.

B. Inclusion of Exhibit 4 in Contract Agreement shall not be misconstrued as acceptance of the Cost Breakdown “Schedule of Values”. Exhibit 4 Cost Breakdown “Schedule of Values” sheet shall be submitted to University’s Project Manager for review. Contractor shall revise and resubmit Exhibit 4 Cost Breakdown “Schedule of Values” as required to comply with requirements of the Contract Documents.

1.04 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 Cost Breakdown “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 Unit Price Work or 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.

1.05 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.

1.06 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 II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION – Not Applicable to this Section

END OF SECTION 01 29 00
SECTION 01 31 00
COORDINATION

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 Composite Panel System: Refer to section 07 42 43

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.
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.

2. Vacate Basement Rooms – refer to drawings AD110A & AD110B.

3. Vacate 1st Floor Rooms - refer to drawings AD111A & AD111B.

4. Vacate 3rd Floor Rooms – refer to drawing AD113A.

5. Vacate 4th Floor Rooms – refer to drawing AD114A.

6. Vacate 5th Floor Rooms – refer to drawing AD115A.

7. Vacate 6th Floor Rooms – refer to drawing AD116A.

8. Vacate 7th Floor Rooms – refer to drawing AD117A.

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 casework and 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 and casework. 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: Hospital Seismic Upgrade Increment 3

UCDMC RFS #: ___________________________

A/C #: 9559040 OSHPD #: 1140010-34-03 CONTRACTOR RFS #: ___________________________

TODAY’S DATE: ____________ SHUTDOWN DATE: ____________ SUSPEND DATE: ____________

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@ucdavis.edu
Attention: Dave Brooks

FROM: ____________________________

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

Shutdown Work (Utility Specific):

Scope (Brief Description of Work):

Impact (Areas & Users):

Additional Comments:

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@ucdavis.edu
Attention: Dave Brooks

FROM: ____________________________
DIG NOTIFICATION FORM

A/C #: 9559040  OSHPD #: I140010-34-03  DATE: _________________

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 Contractors & Subcontractors.

B. Deferred Approvals.

1.2 RELATED SECTIONS

A. Section 01 45 00 – Quality Control.

B. Section 01 31 00 – Coordination

C. Section 01 45 01 – Seismic Control OSHPD

D. Section 01 77 00 – Closeout Procedures.

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. 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).

California Code of Regulations, Title 24, Part 1 – California Administrative Code.

4. 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. Weather Protection for Gypsum Wallboard.
   a. Submit in accordance with CAC Section 7-126 and OSHPD CAN No. 2-2508.2.1, including documents which clearly describe how weather protection will be accomplished prior to the installation of gypsum wallboard.

2. Automatic fire sprinkler system.
3. Automatic fire alarm system.
4. Electrical service arrangement and substations.
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 any changes to the approved Construction Documents construed as a “material alteration” per OSHPD CAN 2-107.4 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 01 31 15
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

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

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.

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SECTION 01 32 00

CONTRACT SCHEDULES

PART I - GENERAL

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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 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
SECTION 01 32 16
SCHEDULES & PROJECT PLANNING

PART I - GENERAL

1.1 RELATED DOCUMENTS AND SPECIFICATION SECTIONS (Not Used)

1.2 DEFINITIONS

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

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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.

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I. Milestone - An element of the schedule that reflects the planned point in time for the start,
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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.

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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; 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 insuffic ient 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 16
SECTION 01 33 00
SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART I - GENERAL

1.01 SECTION INCLUDES

A. Administrative requirements for shop drawings, product data and samples submittal

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. Field Samples and mock-ups

H. Submittal Schedule requirements

1.02 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.

1.03 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 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 61 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.

1.04 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: Submit the number of copies Contractor will need, plus five (5) copies for University use.

2. Initial/Re-submitted Shop Drawing Review(s): Submit eight (8) complete opaque reproductions for University's Representative review and comments.

3. Final Shop Drawing Review and Approval: After obtaining University's Representative approval of initial/re-submitted shop drawing submittals, as described in Section 1.04.C.2 above, Contractor shall submit one (1) reproducible transparency and two (2) opaque reproductions. After University's Representative final shop drawings approval is obtained, University will make all necessary prints for University's and will return reproducible transparency set to Contractor for their use. Contractor is responsible for providing all approved shop drawings for their use and their subcontractors and or suppliers use.

4. Samples: Submit number specified. 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. 09 25 00 – 1 First submittal for Section 09250 – Gypsum Board

2. 09 25 00 – 2 Second submittal for Section 09250 – Gypsum Board

3. 09 25 00 – 2A Re-submittal of second submittal for Section 09 25 00 – Gypsum Board

4. 09 25 00 – 2B Second re-submittal of second submittal for Section 09 25 00 – 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.

1.05 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.

1.06 FIELD SAMPLES AND MOCK-UPS

NOT USED

1.07 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 II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION – Not Applicable to this Section

END OF SECTION 01 33 00
PART I - GENERAL

1.01 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.

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

PART II - DEFINITIONS

2.01 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.

2.02 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.

2.03 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.

2.04 Code Red – Fire

2.05 Code White – Hazardous Material / Chemical Spill

2.06 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.

2.07 External Disasters – those disasters taking place in the community or region or in UCDHS facilities other than the Main Hospital.

2.08 Internal Disasters – those disasters taking place within the Main Hospital.

2.09 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 III - PROCEDURES

3.01 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 34 00
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]

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
SECTION 01 39 00
SUSTAINABLE DESIGN REQUIREMENTS

PART 1  GENERAL

1.1  SECTION INCLUDES:

1.2  RELATED SECTIONS

A.  Section 01 39 02 – Construction Waste Management.
B.  Section 01 39 01 – Indoor Air Quality Requirements.
C.  Section 01 39 03 – General Commissioning Requirements.
D.  Section 01 56 01 – Airborne Contaminants Control.

1.3  REFERENCES

A.  The publications listed below form a part of this specification 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:

4.  Forest Stewardship Council (FSC) STD-01-001, "FSC Principles and Criteria for Forest Stewardship."


14. 2013 California Green Building Standards Code, also known as “CALGreen.”

1.4 DEFINITIONS

A. Definitions pertaining to sustainable development: As defined in ASTM E2114 and as specified in this Section.

B. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

C. LEED: Leadership in Energy & Environmental Design.

D. Rapidly Renewable Materials, LEED-CI Requirements: Materials made from plants that are typically harvested within a ten year or shorter cycle. Rapidly renewable materials include products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, or wool.

E. Regional Materials, LEED-CI Requirements: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted, harvested or recovered, as well as manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

F. Recycled Content, LEED-CI Requirements: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.

2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

G. Environmentally Preferable Products: Products and services that have a lesser or reduced effect on the environment in comparison to conventional products and services.

H. Indoor Air Quality (IAQ): The composition and characteristics of the air in an enclosed space that affect the occupants of that space. The indoor air quality of a space refers to the relative quality of air in a building with respect to contaminants and hazards and is determined by the level of indoor air pollution and other characteristics of the air, including those that impact thermal comfort such as air temperature, relative humidity and air speed.

I. Renewable Resource: A resource that is grown, naturally replenished, or cleansed, at a rate which exceeds depletion of the usable supply of that resource. A renewable resource can be exhausted if improperly managed. However, a renewable resource can last indefinitely with
proper stewardship. Examples include trees in forests, grasses in grasslands, and fertile soil.

J. Stewardship: Responsible use and management of resources in support of sustainability.

K. Green Building Certification Institute (GBCI): Independent third-party entity which provides certification and verification of green buildings under USGBC’s LEED Rating System.

L. LEED Online: Online tool for submittal of required LEED compliance documentation to the Green Building Certification Institute (GBCI).

M. LEED Progress Reports: Monthly submittals that indicate Contractor’s progress toward achievement of LEED prerequisites and credits.

N. LEED Action Plans: Submittals that estimate how LEED requirements will be met by Contractor for applicable LEED credits. LEED ActionPlans contain anticipated product data and estimated costs as applicable to identify a plan for compliance with materials-related LEED credits.

O. LEED Closeout Phase: The period between end of project construction and final LEED Certification ruling by Green Building Certification Institute (GBCI).

P. U.S. Green Building Council (USGBC): Non-profit organization that develops the LEED green building certification system for rating the design, construction, and operation of green buildings.

1.5 LEED SUBMITTALS – NOT USED

1.6 LEED COMPLIANCE DOCUMENTATION – NOT USED

1.7 QUALITY ASSURANCE – NOT USED

1.8 ENVIRONMENTAL PROTECTION – ALSO REFER TO SECTION 01 39 01 & SECTION 01 56 01

A. Preserve the natural resources in their existing condition or restore to an equivalent or improved condition within the Project boundaries and outside the limits of permanent Work performed under this Contract.

B. Site Disturbance: Confine demolition and construction activities to work area limits indicated on Drawings.

C. Air Resources:
   1. Indoor Air Quality (IAQ):
      a. Develop and implement a Construction Indoor Air Quality Management Plan for the construction and pre-occupancy phases. Refer to Section [NEW], Indoor Air Quality Requirements.
      b. Upon completion of the Work, during final acceptance procedures, and prior to occupancy; conduct a building flush-out or baseline IAQ testing as specified in Section 01 39 01, Indoor Air Quality Requirements.
   2. Prevent creation of dust, air pollution, and odors. Refer to Division 01 requirements.
3. Manage and control hazardous materials and waste.

D. Noise and Acoustics: Manage and control construction activity noise.

1.9 CONSTRUCTION WASTE MANAGEMENT

A. Develop and implement a Construction Waste Management Plan. Refer to Section 01 39 02, Construction Waste Management and Disposal.

1.10 CONTRACTOR’S ENVIRONMENTAL TRAINING PROGRAM – NOT USED

1.11 COMMISSIONING

A. Comply with Project building systems commissioning requirements; refer to Section 01 39 03 – Commissioning.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT OF MATERIALS – REFER TO SECTION 01 39 02

2.2 REGIONAL MATERIALS – NOT USED

2.3 CERTIFIED WOOD – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 01 39 00
SECTION 01 39 01
INDOOR AIR QUALITY REQUIREMENTS

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Construction indoor air quality management plan.
B. HVAC protection.
C. Construction sequencing to control emissions.
D. Building flush-out.
E. Independent materials testing.
F. Baseline indoor air quality testing.

1.2  RELATED SECTIONS

A. Section 01 77 00 – Closeout Procedures.
B. Section 01 39 00 – Sustainable Design Requirements.
C. Section 01 39 03 – General Commissioning Requirements.
D. Division 23 Sections for Heating, Ventilating and, Air Conditioning.

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. ASHRAE 52.2 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
1.4 INDOOR AIR QUALITY GOALS

A. Owner has set indoor air quality goals for project construction site operations within the limits of the construction schedule, Contract Sum, available materials, products, and services.

B. The general intent is to prevent air quality problems resulting from construction processes in order to help sustain the comfort and well-being of construction workers and building occupants.

1.5 DEFINITIONS

A. Definitions pertaining to sustainable development: As defined in ASTM E2114 and as specified in this Section.

B. Adequate Ventilation: Ventilation, including air circulation and air changes, required to cure materials, dissipate humidity, and prevent accumulation of dust fumes, vapors, or gases.

C. Environmental Pollution and Damage: The presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances; or degrade the utility of the environment for aesthetic, cultural, or historical purposes.

D. Hazardous Materials: Any material that is regulated as a hazardous material in accordance with 49 CFR 173, requires a Safety Data Sheet (SDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have the potential to meet the definition of a Hazardous Waste in accordance with 40 CFR 261 and Title 22 CCR, Section 66261.3 et seq. Hazardous materials include pesticides, biocides, and carcinogens as listed by recognized authorities, such as the Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC).

E. Indoor Air Quality (IAQ): The composition and characteristics of the air in an enclosed space that affect the occupants of that space. The indoor air quality of a space refers to the relative quality of air in a building with respect to contaminants and hazards and is determined by the level of indoor air pollution and other characteristics of the air, including those that impact thermal comfort such as air temperature, relative humidity and air speed.

F. Sustainability: The maintenance of ecosystem components and functions for future generations.

1.6 SUBMITTALS

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

B. Product Data: Submit product data for filtration media used during construction and during operation. Data to include Minimum Efficiency Reporting Value (MERV).

C. SDS: Submit SDSs for inclusion in Operation and Maintenance Manual for the following products. Coordinate with Section 01 77 00.
   1. Adhesives.
   2. Floor and wall patching and leveling materials.
3. Caulking and sealants.
4. Insulating materials.
5. Fireproofing and firestopping.
6. Carpet.
7. Paint.
9. Lubricants.

1.7 LEED COMPLIANCE DOCUMENTATION – NOT USED

1.8 CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN

A. Develop and implement an IAQ Management Plan for the construction and pre-occupancy phases.

B. Submit IAQ Management Plan to Architect and Owner within sixty days after receipt of Notice of Award.

C. Requirements of IAQ Management Plan:
   1. After construction ends, prior to occupancy and with all interior finishes installed, install new filtration media and perform a building flush-out in accordance with LEED standards.
   3. Protection of stored on-site or installed absorptive materials from moisture damage.
   4. If permanently installed air handlers are used during construction, filtration media with minimum MERV 8 rating must be used at each return air grille. Replace all filtration media immediately prior to occupancy.
   5. In lieu of building flush-out, Contractor may opt to conduct a baseline IAQ testing procedure consistent with US EPA’s current Compendium of Methods for the Determination of Air Pollutants in Indoor Air, and LEED standards.
   6. If a building flush out is to be implemented, include anticipated path to achieving flush out. Include air volume calculations, and environmental conditions to be monitored and maintained. Include a project schedule with flush-out strategy shown, indicating time and duration of flush-out method.
   7. If air quality testing is to be implemented, include testing procedures, environmental conditions to be monitored, pollutants and the required limits that will be tested, and anticipated testing locations. Include a schedule with duration of testing noted.

1.9 SMACNA APPROACHES

A. HVAC Protection:
2. Remove oil film on HVAC sheet metal work prior to shipment to site. Seal with plastic sheet both ends of cleaned and dried sheet metal ductwork and on HVAC equipment prior to shipment to site.

3. Install HVAC system, continuously maintaining a sealed system by removing covers of sealed ducts and equipment only prior to installation and keeping free ends sealed.

4. If air handlers must be used during construction, use filtration media with a minimum MERV 8 filtration media at each return air grill, as per ASHRAE 52.2. Air handlers may be used only as a last resort and with the written approval of Owner. Clean air handlers using a high efficiency particulate air (HEPA) vacuum cleaner prior to substantial completion and prior to using the air handlers to circulate air.

B. Scheduling:

1. Finish Types: Finishes, for the purpose of this Section, are classified based on its potential to emit or off-gas deleterious particulate matter and its tendency to absorb.

   a. Type 1 Finishes: Materials and finishes which have a potential for short-term levels of off-gassing from chemicals inherent in their manufacturing process, or which are applied in a form requiring vehicles or carriers for spreading which release a high level of particulate matter in the process of installation or curing. Type 1 finishes include, but are not limited to the following:
      1) Composite wood products.
      2) Adhesives, sealants, and glazing compounds.
      3) Wood preservatives.
      4) Paints and coatings.
      5) Control and expansion joint fillers.
      6) Hard finishes requiring adhesive for installation.
      7) Gypsum board and associated finish processes.

   b. Type 2 Finishes: Materials and finishes which are woven, fibrous, or porous in nature and tend to absorb chemicals off-gassed by Type 1 finishes or may be adversely affected by particulates. These materials become sinks for deleterious substances which may be released much later, or collectors of contaminants that may promote subsequent bacterial growth. Type 2 finishes include, but are not limited to the following:
      1) Carpet.
      2) Fabric wall covering.
      3) Insulation exposed to air stream.
      4) Acoustical ceiling and wall materials.
      5) Fabric covered acoustical wall panels.
      6) Upholstered furnishings.

2. Optimal Order of Finish Installation: To the greatest extent possible, and as mitigated by project requirements, schedule work activities to accommodate the following:

   a. Apply Type 1 interior finishes throughout the entire air zone of each building or building segment and allow finishes to completely cure according to intervals and
times stated in respective finish manufacturer’s printed instructions before commencing installation of any Type 2 finishes in the same area.

b. Avoid storage of Type 2 finishes in areas where installation or curing of Type 1 materials are in progress.

c. Apply Type 2 finishes.

C. HOUSEKEEPING

1. Employ measures to keep a clean jobsite. Regularly sweep and wet mop. Use low-VOC cleaning products as part of housekeeping operations.

D. PATHWAY INTERRUPTION

1. Use temporary barriers to separate construction activities from occupied areas.

2. Constrain construction activities that generate a large amount of dust, such as wood cutting or drywall cutting areas.

3. Exhaust areas in such a way to create negative pressure.

E. SOURCE CONTROL

1. Address sources of construction pollution and strategies to limit them.

2. Use low-VOC materials per requirements in Section 01 39 00: Sustainable Design Requirements. Store VOC-containing materials away from absorptive materials.

3. Limit indoor machine exhaust or exhaust directly to the outdoors.

1.10 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Maintain construction indoor air quality consistent with the project’s general intent of providing optimal indoor air quality to help sustain the comfort and well-being of construction workers and building occupants and also to provide the proper site environmental conditions for materials installation.

2. Condition work areas for materials before, during, and after installation as specified in individual specification sections. Provide portable fans, portable ducts, and dehumidification systems as needed to provide continuous ventilation, temperature, and humidity control; and to prevent mold growth. Provide construction climate control system (dehumidifiers, chillers, and heaters) by Munters Corporation., Martinez, CA; 800-686-8377; 925-957-8970; www.muntersamerica.com, or accepted equal system. Costs related to controlling and conditioning construction environment are part of construction process and shall be borne by Contractor.

B. Compartmentalization:

1. Isolate areas of work to prevent contamination of clean or occupied areas. Depending on the climate, ventilate 100 percent outside air to exhaust contaminated air directly to outside during installation of VOC emitting materials.

2. Utilize pressure differentials to prevent contaminated air from entering clean areas.

END OF SECTION 01 39 01
SECTION 01 39 02
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Special requirements for waste management during demolition and construction operations.
   1. Salvaging nonhazardous waste.
   2. Recycling nonhazardous waste.
   3. Disposing of nonhazardous waste.

B. Environmental protection requirements, both on-site and off-site, during demolition and construction operations.

1.2 RELATED SECTIONS

A. Section 01 56 00 – Temporary Barriers, Enclosures and Controls.

B. Section 01 61 00 – Product Requirements.

C. Section 01 39 00 – Sustainable Design Requirements; for requirements of LEED for Commercial Interiors, 2009 Edition.

D. Division 04 and 09 Sections: For disposition of masonry and stone waste and excess materials.

E. “Division 31” Sections: For disposition of waste resulting from site clearing and removal of above- and below-grade site improvements.

1.3 REFERENCES

A. The publications listed below form a part of this specification 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:
   2. 2013 California Green Building Standards Code (CalGreen), Part 11 of Title 24.

1.4 WASTE REDUCTION GOALS

A. The Owner has set a waste minimization goal for the project, within the limits of the construction schedule, contract sum, and available materials, equipment, products, and services.
B. Minimize the amount of construction waste generated. The project goal is to recycle, salvage, or reuse at least 75 percent, as applicable, of the waste generated that may otherwise be disposed in a solid waste disposal facility (landfill).

C. Divert waste generated by construction, demolition, and land clearing activities from disposal through reuse (salvage) and recycling.
   1. Diversion of land clearing and soil debris shall not contribute to achievement of LEED waste diversion goals.

D. Reduce waste generated using effective construction resource management practices in materials estimating, ordering, shipping, storage, installation, and disposal.

E. Manage construction waste using best management practices to prevent contacting, contaminating, and polluting storm water run-off.

1.5 DEFINITIONS

A. Definitions pertaining to sustainable development: As defined in ASTM E2114 and as specified in this Section.


C. Class III Landfill: A landfill that accepts non-hazardous waste such as household, commercial, and industrial wastes, including construction, remodeling, repair, and demolition operations.

D. Construction Waste: As defined in Title 14, CCR, Section 17225.15. Includes waste building materials, packaging and rubble resulting from construction, remodeling, repair, and demolition operations on pavements, houses, commercial buildings and other structures.

E. Construction and Demolition (C&D) Waste: Solid waste that is a portion of the construction waste stream and are source separated or separated for reuse solid waste and recyclable materials, including commingled and separated materials resulting from construction work that are not hazardous, and contains no more than one percent putrescible waste by volume.

F. Conversion Rate: The rate set forth in the standardized Conversion Rate Table (see table at end of this Section) for use in estimating the volume or weight of materials identified in the Construction Waste Management Plan.

G. Divert: To use material for any purpose other than disposal in a landfill or transformation facility.

H. EA: Enforcement Agency as defined by California Public Resources Code (PRC) Section 40130.

I. Environmental Pollution and Damage: The presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances; or degrade the utility of the environment for aesthetic, cultural, or historical purposes.
J. Hazardous Materials: Any material that is regulated as a hazardous material in accordance with 49 CFR 173, requires a Safety Data Sheet (SDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have the potential to meet the definition of a Hazardous Waste in accordance with 40 CFR 261 and Title 22 CCR, Section 66261.3 et seq. Hazardous materials include pesticides, biocides, and carcinogens as listed by recognized authorities, such as the Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC).

K. Hazardous Waste: As defined in 40 CFR 261 and Title 22 CCR, Section 66261.3 et seq.

L. Putrescible Waste: Solid waste capable of being decomposed by micro-organisms with sufficient rapidity as to cause nuisance because of odors, vectors (insects, rodents, or any other animal capable of transmitting causative agents of human disease), gasses, or other offensive conditions, and include materials such as, but not limited to food wastes, offal and dead animals.

M. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

N. Recycle: To remove a waste material from the Project site to another site for remanufacture into a new product for reuse by others.

O. Recycling: The process of sorting, cleaning, treating, and reconstituting materials for the purpose of using the material in the manufacture of a new product. Can be conducted on-site (as in the grinding of concrete and reuse on-site).

P. Recycling Facility: An operation that can legally accept materials for the purpose of processing materials into an altered form for the manufacture of a new product. Recycling facilities have their specifications for accepting materials.

Q. Reuse: Making use of a material without altering its form.

R. Salvage: Recovery of materials for on-site reuse or donation to a third party.

1.6 SUBMITTALS

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

B. Pay Application Requirements as described in this Section including but not limited to: Waste Management Log, receipts, invoices, weigh tickets and a summary sheet.

1.7 QUALITY ASSURANCE

A. C&D Recycling Facility Qualifications:
   1. Operations legally qualified to accept C&D waste in compliance with CIWMB rules and regulations and the local Enforcement Agency. A list of C&D Recycling Facilities is available through the CIWMB and its Internet recyclers’ database www.ciwmb.ca.gov/ConDemo/Recyclers.

B. Regulatory Requirements: Comply with CIWMB and local EA rules and regulations.

C. Measurement:
1. At Contractor’s option, waste shall be measured consistently throughout Project using one of the following:
   a. Weight.
   b. Volume.

2. Refer to conversion table at the end of this Section for weight/volume conversion rates.

D. Monitoring:

1. Maintain log of each load, of each category item diverted from landfill. Log in separately debris sent to a Class III landfill and materials sent to recycling facilities.
   a. Include in log: type of load, load volume, recycling/hauling service, date accepted by recycling service or by landfill.
   b. Owner reserves the right to audit the log at any time, retain all weight tickets, and receive copies of receipts and invoices.
   c. Units of measure: Use same units as stated in the approved plan good faith estimate of construction waste which would be generated if no remedial methods were implemented.

2. Contractor shall monitor removal of C&D debris to verify the required material designated to be recycled are being properly sorted and removed from site to be delivered to recycling facility. Contractor shall coordinate with Project Inspector to have all loads, recycled and non-recycled, verified prior to off-haul. Project Inspector shall initial all receipts, invoices, manifests and weigh tickets.

3. Additional Pay Application Requirements: Submit the following as a requirement for pay application:
   a. Waste Management Log with attached receipts, invoices, weigh tickets and a summary sheet duly initialed by Project Inspector.
   b. Certification letter stating that, under the penalty of perjury, all materials removed from the site during the billing period are included in the waste management log, summary sheet, and attachments.
   c. Failure to submit these requirements with pay application will prohibit processing of pay application.

4. Coordination, Meetings, Training: Comply with provisions specified in this Section.

1.8 CONSTRUCTION WASTE MANAGEMENT PLAN

A. Within 14 days after receipt of Notice of Award and prior to any waste removal from the project site, Contractor shall develop and submit to Architect and Owner a Construction Waste Management Plan as specified in this Section for review.

B. The Construction Waste Reduction Plan shall, as a minimum, address the following:

1. Statement of Waste Management Goals indicating objective to reuse, salvage, and recycle of at least 75 percent, as applicable, of the waste generated.

2. Provide a good faith estimate of total project construction waste to be generated if no diversion methods were implemented. Identify name of landfill(s) where project construction waste would normally be disposed of, tipping fees, and estimated cost of
disposing project construction waste in landfill(s).

3. Calculate quantities using the Conversion Rate Table included in this Section. Quantities may be calculated by weight or by volume, but not both. Units must be consistent throughout project.

4. Types and estimated quantities (where reasonably available) of salvageable materials that are expected to be generated during demolition and construction activities.

5. Methods to be used to salvage or reuse materials on-site. Methods shall include one or more of the following options: contracting with a deconstruction specialist to salvage all or most materials generated, and reuse of materials on-site or in new construction.

6. Methods to be used to recycle materials. Methods shall include one or more of the following: requiring subcontractors to take materials back for recycling at a permitted facility, contracting with a full service recycling service to recycle all or most materials at a permitted facility, processing and reusing materials on-site.

7. Identify C&D recycling facilities that will receive C&D debris. Include as attachments each recycling facility’s specifications for accepting materials.

8. Describe construction site facilities, implements, and procedures for collecting, separating, storing, and hauling, each type of C&D debris. Clearly label recycling containers – post acceptable/unacceptable materials. Identify hauler(s) of each particular debris item, who have agreed to accept and divert designated item from landfill.

9. Identify on-site parties responsible for implementing the Construction Plan.

10. As a minimum, the following materials shall be reused or recycled:
   a. Land clearing debris.
      1) Weight/volume of land clearing debris shall not be applied towards achievement of LEED goals.
   b. Asphalitic concrete.
   c. Concrete.
   d. Metals.
   e. Wood.
   f. Plywood, oriented strand board (OSB), medium density fiberboard (MDF), and other wood sheet materials.
   g. Rigid foam.
   h. Window glass.
   i. Gypsum board.
   j. Acoustical ceiling panels.
   k. Carpet.
   l. Paint (through hazardous waste outlets).
   m. Piping: steel, copper, plastic, and cast iron.
   n. Fluorescent lights and ballasts.
   o. Cardboard, paper, plastic film, and packaging.
   p. Job-shack wastes, including office paper, cardboard, glass, plastic, and aluminum beverage cans.
11. Describe methods to prevent storm water run-on from contacting stored construction waste. Methods may include but not limited to berms, secondary containment, and covered dumpster/roll-offs. Where dumpsters are used, include number of dumpsters and frequency of pick-up.

C. Plan Implementation LEED – NOT USED

1.9 SPECIAL PROGRAMS & TAX REBATES – NOT USED

1.10 CONVERSION TABLE

A. Use the following conversion table for the necessary conversion of material quantities.

<table>
<thead>
<tr>
<th>Material</th>
<th>Lbs/cy</th>
<th>Tons/cy</th>
<th>Cy/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>300 lbs/cu.yd.</td>
<td>0.15 tons/cu.yd.</td>
<td>6.7 cu yds/ton</td>
</tr>
<tr>
<td>Cardboard</td>
<td>100 lbs/cu.yd.</td>
<td>0.05 tons/cu.yd.</td>
<td>20 cu yds/ton</td>
</tr>
<tr>
<td>Drywall</td>
<td>500 lbs/cu.yd.</td>
<td>0.25 tons/cu.yd.</td>
<td>4 cu.yds/ton</td>
</tr>
<tr>
<td>Concrete/Asphalt</td>
<td>1400 lbs/cu.yd.</td>
<td>0.7 tons/cu.yd.</td>
<td>1.4 cu. yds/ton</td>
</tr>
<tr>
<td>Mixed Waste</td>
<td>350 lbs/cu.yd.</td>
<td>0.175 tons/cu.yd.</td>
<td>5.7 cu.yds/ton</td>
</tr>
</tbody>
</table>

Source: Resource Efficient Building (1994), Metro Solid Waste Department, Portland, Oregon

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Architect and Owner. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

3.2 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill acceptable to authorities having jurisdiction.

B. Burning: Do not burn waste materials on Owner’s property.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them off-site.

END OF SECTION 01 39 02
SECTION 01 39 03
COMMISSIONING

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.
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. Pre-functional checklists are developed by the CXA and completed by the appropriate installing contractors for all major equipment and systems being commissioned before functional testing can begin. The checklist captures equipment nameplate and characteristics data, confirming the as-built status of the equipment or system. These checklists also ensure that the systems are complete and operational, so that the functional performance testing can be scheduled. The contractor and vendors shall execute factory startup and provide the cxa with a copy of the signed and dated completed start-up checklists which will be submitted with the pre-functional checklists.

B. 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.

C. 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 Owner’s representative and Contractor.

F. 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.

G. Test failure: when a major or minor problem is encountered that prevents the completion of the CX testing procedure, the test will be aborted and rescheduled. When a minor problem is encountered that does not prevent the completion of the CX testing procedure, the problem will be documented and the contractor will address the problem prior to commencing with additional CX testing.

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, and Specification Section 01 45 50, subsection 1.5 D.

3.5 COMMISSIONED SYSTEMS

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>EQUIPMENT</th>
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<td></td>
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<td>Smoke Control Sequence of Operation</td>
<td>5</td>
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<td></td>
<td>Thermal Storage</td>
<td>5</td>
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<td></td>
<td>Security System</td>
<td>5</td>
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</table>
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 contractor 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 contractor 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 I - GENERAL

1.01 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

1.02 RELATED SECTIONS

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

1.03 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 then 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.

1.04 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 Elevator Safety Construction Code – Title 24 Part 7

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


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

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

m. 2013 NFPA 13 – Installation of Sprinkler Systems

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

o. 2013 NFPA 72 – National Fire Alarm Code

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

q. 2005 NFPA 99 – Health Care Facilities


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

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

u. 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

v. Americans with Disabilities Act (ADA) 2010
w. OSHPD
x. Rules and regulations of private and public utilities
y. American National Standards Institute (ANSI)
z. American Society of Testing Materials (ASTM)
aa. Federal Specifications (Fed. Spec.)
bb. Underwriters Laboratories
cc. 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”.

1.05 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.

1.06 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.

1.07 DEFERRED APPROVAL
A. Where noted in the Contract Documents, certain items of materials and/or systems may require OSHPD/SFM 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 II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION – Not Applicable to this Section

END OF SECTION 01 41 00
PART I - GENERAL

1.01 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

1.02 RELATED SECTIONS

A. Section 01 41 00 – REGULATORY REQUIREMENTS

1.03 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 (OFCI): 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 (UFCD): Same as Owner-Furnished/Contractor-Installed.
1.04 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.

1.05 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:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>Aluminum Association</td>
</tr>
<tr>
<td>AAA</td>
<td>American Arbitration Association</td>
</tr>
<tr>
<td>AAC</td>
<td>Architectural Anodizers Council</td>
</tr>
<tr>
<td>AABC</td>
<td>Associated Air Balance Council</td>
</tr>
<tr>
<td>AAMA</td>
<td>American Architectural Manufacturers Association</td>
</tr>
<tr>
<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials</td>
</tr>
<tr>
<td>ACI</td>
<td>American Concrete Institute</td>
</tr>
<tr>
<td>ACMA</td>
<td>American Concrete Pipe Association</td>
</tr>
<tr>
<td>ACRA</td>
<td>American Concrete Pumping Association</td>
</tr>
<tr>
<td>ADA</td>
<td>Americans with Disabilities Act</td>
</tr>
<tr>
<td>ADC</td>
<td>Air Diffusion Council</td>
</tr>
<tr>
<td>AFSA</td>
<td>American Fire Sprinkler Association</td>
</tr>
<tr>
<td>AGA</td>
<td>American Galvanizers Association (formerly AHDGA)</td>
</tr>
<tr>
<td>AGA</td>
<td>American Gas Association</td>
</tr>
<tr>
<td>AGC</td>
<td>Associated General Contractors of America</td>
</tr>
<tr>
<td>AI</td>
<td>Asphalt Institute</td>
</tr>
<tr>
<td>AIA</td>
<td>American Institute of Architects</td>
</tr>
<tr>
<td>AIMA</td>
<td>Acoustical and Insulation Materials Association</td>
</tr>
<tr>
<td>AISC</td>
<td>American Institute of Steel Construction</td>
</tr>
<tr>
<td>AISI</td>
<td>American Iron and Steel Institute</td>
</tr>
<tr>
<td>AMCA</td>
<td>Air Movement and Control Association International</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>APA</td>
<td>Engineered Wood Association (formerly American Plywood Association)</td>
</tr>
<tr>
<td>APWA</td>
<td>American Public Works Association</td>
</tr>
<tr>
<td>ARMA</td>
<td>Asphalt Roofing Manufacturers Association</td>
</tr>
<tr>
<td>ASAC</td>
<td>American Subcontractors Association of America</td>
</tr>
<tr>
<td>ASCE</td>
<td>American Society of Civil Engineers</td>
</tr>
<tr>
<td>ASHRAE</td>
<td>American Society of Heating, Refrigerating, and Air-Conditioning Engineers</td>
</tr>
<tr>
<td>ASLA</td>
<td>American Society of Landscape Architects</td>
</tr>
<tr>
<td>ASME</td>
<td>American Society of Mechanical Engineers</td>
</tr>
<tr>
<td>ASNT</td>
<td>American Society for Nondestructive Testing</td>
</tr>
<tr>
<td>ASPE</td>
<td>American Society of Plumbing Engineers</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>AWI</td>
<td>Architectural Woodwork Institute</td>
</tr>
<tr>
<td>AWPA</td>
<td>American Wood Preservers’ Association</td>
</tr>
<tr>
<td>AWS</td>
<td>American Welding Society</td>
</tr>
<tr>
<td>AWWA</td>
<td>American Water Works Association</td>
</tr>
<tr>
<td>BHMA</td>
<td>Builders Hardware Manufacturers Association</td>
</tr>
<tr>
<td>BOC</td>
<td>Board of Corrections</td>
</tr>
<tr>
<td>CABO</td>
<td>Council of American Building Officials</td>
</tr>
<tr>
<td>CAC</td>
<td>California Administrative Code (see California Code of Regulations (CCR))</td>
</tr>
<tr>
<td>CAL/OSHA</td>
<td>State of California Construction Safety Orders</td>
</tr>
<tr>
<td>CBC</td>
<td>California Building Code</td>
</tr>
<tr>
<td>CCR</td>
<td>California Code of Regulations</td>
</tr>
<tr>
<td>CEC</td>
<td>California Electrical Code</td>
</tr>
<tr>
<td>CFC</td>
<td>California Fire Code</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>CIMA</td>
<td>Construction Industry Manufacturers Association</td>
</tr>
<tr>
<td>CISP</td>
<td>Cast Iron Soil Pipe Institute</td>
</tr>
<tr>
<td>CLFMI</td>
<td>Chain Link Fence Manufacturers' Institute</td>
</tr>
<tr>
<td>CMC</td>
<td>California Mechanical Code</td>
</tr>
<tr>
<td>CPC</td>
<td>California Plumbing Code</td>
</tr>
<tr>
<td>CRSI</td>
<td>Concrete Reinforcing Steel Institute</td>
</tr>
<tr>
<td>CSI</td>
<td>Construction Specifications Institute</td>
</tr>
<tr>
<td>CTIOA</td>
<td>Ceramic Tile Institute of America, Inc.</td>
</tr>
<tr>
<td>DHI</td>
<td>Door and Hardware Institute</td>
</tr>
<tr>
<td>DSA</td>
<td>Division of the State Architect</td>
</tr>
<tr>
<td>EJMA</td>
<td>Expansion Joint Manufacturers Association</td>
</tr>
</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.
E. Additional abbreviations, used on the Drawings, are listed thereon.

PART II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION – Not Applicable to this Section

END OF SECTION 01 42 00
PART I - GENERAL

1.01 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

1.02 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 05 – INSPECTION OF WORK
D. Section 01 61 00 – PRODUCT REQUIREMENTS: Product Options, substitutions, transportation and handling requirements, storage and protection requirements, and system completeness requirements.

1.03 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.

1.04 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.

1.05 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.

1.06 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.

1.07 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.

1.08 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.

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:

<table>
<thead>
<tr>
<th>Material/Tests</th>
<th>Inspections and Tests Paid by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Reinforcement</td>
<td>Reinforcement Inspection</td>
</tr>
<tr>
<td>Reinforcement Strength</td>
<td></td>
</tr>
<tr>
<td>Cast In Place</td>
<td>Slump Tests</td>
</tr>
<tr>
<td>Compressive Strength Tests</td>
<td></td>
</tr>
<tr>
<td>Structural Steel</td>
<td>Welding Inspection</td>
</tr>
<tr>
<td>High-strength Bolting Inspection</td>
<td></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.
1.09 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 05 – INSPECTION OF WORK, Item 1.05, 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.

1.12 GEOTECHNICAL ENGINEER

A. University will retain and pay the expense of a Geotechnical Engineer to perform inspection, testing and observation functions specified by University. Geotechnical Engineer will communicate only with University. University's Representative shall then give notice to Contractor, of any action required of Contractor.
PART II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION – Not Applicable to this Section

END OF SECTION 01 45 00
PART 1 - GENERAL

1.01 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.

1.02 QUALITY ASSURANCE

A. ASTM standards

C. 2013 California Building Code, Title 24 (CBC)

1.03 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

2.01 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, said 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
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 2-½” conduit plus contents, brace trapeze system in accordance with NUSIG/Badger Industries.

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

   **CONDUIT PLUS CONTENTS WEIGHT DATA**

<table>
<thead>
<tr>
<th>EMT SIZE (IN)</th>
<th>LBS/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>½</td>
<td>0.53</td>
</tr>
<tr>
<td>¾</td>
<td>0.88</td>
</tr>
<tr>
<td>1</td>
<td>1.30</td>
</tr>
<tr>
<td>1-¼</td>
<td>1.90</td>
</tr>
<tr>
<td>1-½</td>
<td>2.70</td>
</tr>
<tr>
<td>2</td>
<td>4.40</td>
</tr>
<tr>
<td>2-½</td>
<td>5.70</td>
</tr>
<tr>
<td>3</td>
<td>9.40</td>
</tr>
<tr>
<td>3-½</td>
<td>10.00</td>
</tr>
<tr>
<td>4</td>
<td>12.50</td>
</tr>
</tbody>
</table>

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 braced in accordance with these guidelines and SMACNA details.

23. SMACNA details shall not be used without prior approval by Structural Engineer.
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

3.01 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.

3.02 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 threaded shell-type anchors and displacement controlled anchors (e.g., drop-in 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 01 45 01
PART I - GENERAL

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

1.02 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

1.03 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

1.04 PROJECT INSPECTIONS AND TESTING PROCEDURES
   A. Inspections: This Project is under the jurisdiction of the Office of Statewide Health Planning and Development (OSHPD). Refer to the attached OSHPD Testing, Inspection and Observation Program for specific inspection and testing requirements. Also see Part 3 for non-OSHPD inspection items or Part 3, Item 3.12 for additional OSHPD requirements. Examples of required inspections:
      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.

1.05 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 1.07.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 1.07.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 then normal work hour inspections. University's Representative shall have final authority in setting times of off-hour inspections.

D. Re-inspections:

1. More than 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 II - PRODUCTS – Not Applicable to this Section

PART III - 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.

3.01 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%.

3.02 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.

3.03 FIRE ALARM SYSTEM (Title 24; Part 9, Article 1006)
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).

3.04 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).

3.05 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).

3.06 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).

3.07 KITCHEN HOOD FIRE SUPPRESSION SYSTEM (Title 24, Part 9, Article 10, Section 1005; Part 9, Section 10.513)
A. Approved drawings shall be on job-site from start to completion of project.
B. State Fire Marshal to witness system test.

3.08 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).

3.09 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.

3.10 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.

3.11 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.

3.12 OSHPD – Testing, Inspection and Observation Program

See attached OSHPD Testing, Inspection and Observation Program for inspection and testing requirements.

END OF SECTION 01 45 05
### INSPECTION REQUEST

**A/C #:** __________  **OSHPD #:** __________  **UCDHS IR #:** __________  **Contractor IR #:** __________  **Date:** __________

**Project Name:** __________  **Spec Section(s):** __________

---

**To:** UC Davis Health System (UCDHS)  
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:** __________

**Project Schedule Activity ID No.:** __________  **Date of Inspection:** __________  **Time Requested:** __________

**Type of Inspection:** __________

**Location of Inspection (i.e., Floor, Column Line, etc.):** __________

---

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: __________________________  Date: ___________

---

**UDCWS USE ONLY**

**Date Received:** __________  **Re-inspection Requested for Previous UCDHS IR #:** __________  **Time of Inspection:** __________

**Date of Inspection:** __________  **Inspector:** __________  
**Inspector Arrival Time:** __________  **Inspector Departure Time:** __________  
☐ Inspection Report Attached

**Comments:** __________

---

☐ Approved  ☐ Approved as Noted  ☐ Not Approved  ☐ Cancelled

**Inspection Request Notes or Description of Items of Deficiency if needed below (Part 1, Chapter 7, Section 7-145, item 6)**

---

**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.)*

---

**Project Phase Percentage Complete (% of the phase completed):** __________  **Overall Project Percentage Complete:** __________

---
NON-CONFORMING WORK NOTICE

A/C #: ____________________  OSHPD #: ____________________  Notice #: ____________________  Date: ____________________

To: ____________________  From: UC Davis Health System (UCDHS)
Facilities Design & Construction – Inspection Trailer
4430 V Street, Building 35-A
Sacramento, CA 95817
P: ____________________  F: 916-734-1375
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.

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**Record Name (Scope of Project):**

UCDMC Hospital Seismic Upgrade Projects

### TESTS – DOCUMENTATION / CERTIFICATION REQUIRED

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*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.
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## Testing, Inspection and Observation Program

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### MECHANICAL TESTS

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## Testing, Inspection and Observation Program

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## Testing, Inspection and Observation Program

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<td>Underground fuel storage tank</td>
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| Underground fuel storage tank    | CFC 5704.2.12 & NFPA 33-2012 § 21.5.2 |
| Tightness testing                | FLSD:                            |

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<th>Flammable and combustible liquid fuel piping</th>
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<th>Exterior insulation and finish systems (EIFS)</th>
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| Water-resistant barrier coating              | CBC 1705A.16.1 & ASTM E 2570 |
| Installation over sheathing substrate        | X              |

| Glass and glazing identification             | CBC 2403.1    |
| Manufacturer's material mark inspection      |               |

| Radiation shielding verification             | CBC 3102C     |
| Radiation protection                         |               |

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| Foundation             |       |     | DSE:                           |
| CBC 1705A.7            |       |     | DSE:                           |

| Driven deep foundations|       |     | DSE:                           |

| Foundation             |       |     | DSE:                           |
| CBC 1705A.8            |       |     | DSE:                           |

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| Concrete                                           | CBC 1705A.3 |
| Placement of concrete                              | X            |

| Concrete                                           | CBC 1705A.3 |
| CIP & Post-installed Bolts in concrete              | X            |

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## Testing, Inspection and Observation Program

### 2013 California Building Standards Code – OSHPD 1

### REQUIRED CONSTRUCTION OBSERVATION

*(See "PERSONAL KNOWLEDGE" as defined in California Administrative Code, Section 7-151)*

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### VERIFIED COMPLIANCE REPORT REQUIRED AS INDICATED

(Form OSH-FD-123)

### FINAL VERIFIED COMPLIANCE REPORT AT COMPLETION

|         |   X   |   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, INS), and Inspector of Record (IOR).

OSH-FD-303A (Rev 06/12/14)  STATE OF CALIFORNIA - HEALTH AND HUMAN SERVICES AGENCY  Page 10 of 12
## Testing, Inspection and Observation Program

### 2013 California Building Standards Code – OSHPD 1

### E Samples of Test and Inspection Reports are:

- [ ] 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 tests 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:

Steve Sugioka

C10245

8/25/17

### FOR OFFICE USE ONLY

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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.
PART I - GENERAL

1.01 SECTION INCLUDES

A. Temporary Power and Lighting.
B. Temporary Heating, Cooling & Ventilation.
C. Temporary Water.
D. Temporary Fire Protection.
E. Temporary Telephone.

1.02 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 01 – AIRBORNE CONTAMINANTS CONTROL
D. Section 01 74 00 – CLEANING
E. Section 01 77 00 – CLOSEOUT PROCEDURES

1.03 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.

1.04 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 construction.

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 16 – 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.

1.05 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 SECTON 01 56 01 – 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 1.04.

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.

1.06 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 1 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 15 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 maintenance and removal 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.

1.07 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 that 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.

1.08 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 II - PRODUCTS

2.01 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 III - EXECUTION – Not Applicable to this Section

END OF SECTION 01 51 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)
  - Site contact person: Amy Yee, 916-734-8000
  - 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

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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 I - GENERAL

1.01 SECTION INCLUDES

A. Field Offices and Sheds
B. Temporary Facilities
C. Temporary Sanitary Facilities

1.02 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

1.03 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 (30) 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.

1.04 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.

1.05 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 II - PRODUCTS

2.01 MATERIALS

A. Serviceable, new or used, adequate for required purpose.

PART III - EXECUTION – Not Applicable to this Section

END OF SECTION 01 52 00
PART I - GENERAL

1.01 SECTION INCLUDES
   A. Construction Parking and Access Roads
   B. Traffic Regulation
   C. Project Informational Signs

1.02 RELATED SECTIONS
   A. Section 01 11 00 – SUMMARY OF THE WORK
   B. Section 01 33 00 – 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.

1.03 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.

1.04 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.

1.05 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" (maximum) 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 II - PRODUCTS – Not Applicable to this Section

PART III - 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 01 35 00 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: 01 56 01 ICRA Permit, 01 35 00 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
### UCDMC Construction Dust & Hazardous Materials Inspection Worksheet

<table>
<thead>
<tr>
<th>ICRA Permit Number:</th>
<th>ICRA Class:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job # and Name: 9559040 Stair Tower &amp; Corridor Upgrades – Increment 3</td>
<td>Project Manager: Dave Brooks</td>
</tr>
<tr>
<td>Estimated Start:</td>
<td>Estimated Completion:</td>
</tr>
</tbody>
</table>

#### ACKNOWLEDGEMENT OF HAZARDOUS MATERIALS

Does the project contact hazardous materials (e.g., asbestos, lead, mold, PCBs, mercury)?  Yes / No

Verified How: (e.g., hazmat survey, personal knowledge)

By Whom: (name & department)

#### CONTAINMENT STRATEGIES

<table>
<thead>
<tr>
<th>Enclosure Types</th>
<th>[check all that apply]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Containment (poly over all surfaces not in SOW)</td>
<td>Hard Barriers Required</td>
</tr>
<tr>
<td>Isolated Room – Critical Openings Only (seal doors, supply and return registers, etc)</td>
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</tr>
<tr>
<td>Mini Containment Cube (only large enough for 1-2 people; aka pop up cube)</td>
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<tr>
<td>Shrouded Tool with HEPA filtered exhaust</td>
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<tr>
<td>Glove Box Containment with HEPA filtered exhaust</td>
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<tr>
<td>Other:</td>
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<table>
<thead>
<tr>
<th>Negative Pressure Requirements</th>
<th>[check all that apply]</th>
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</thead>
<tbody>
<tr>
<td>-0.020&quot; wc at all times (24/7) as displayed on mounted manometer</td>
<td></td>
</tr>
<tr>
<td>-0.020&quot; wc at setup with some negative pressure throughout project as displayed on manometer</td>
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</tr>
<tr>
<td>Visual Verification of some negative room pressure throughout project</td>
<td></td>
</tr>
<tr>
<td>No negative room pressure required</td>
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</tr>
<tr>
<td>Negative pressure in localized HEPA exhausted work area (e.g. shrouded tool, glove box)</td>
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<tr>
<td>Other:</td>
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<table>
<thead>
<tr>
<th>Negative Pressure Equipment</th>
<th>[check all that apply]</th>
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<tbody>
<tr>
<td>Onsite Challenge Testing (DOP or particle counting) prior to setup</td>
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<tr>
<td>Challenge Tested within last 6 months; Equipment has remained onsite at UCDMC</td>
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<tr>
<td>Single HEPA Unit; exhausted to: Outdoors Diffusion Box/Chamber</td>
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<tr>
<td>Two HEPA Units in Parallel; exhausted to: Outdoors Diffusion Box/Chamber</td>
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<tr>
<td>Other:</td>
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<thead>
<tr>
<th>Additional Containment Requirements</th>
<th>[check all that apply]</th>
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<tbody>
<tr>
<td>Ante Room</td>
<td>Masonite Floor Protection</td>
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<tr>
<td>Walk off mats</td>
<td>Protective Clothing</td>
</tr>
<tr>
<td>Shoe Covers</td>
<td>Air Scrubber</td>
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<tr>
<td>Other:</td>
<td></td>
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#### VERIFICATION OF WORK

<table>
<thead>
<tr>
<th>Type(s) of Inspection Required</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEPA Equipment Verification</td>
<td>☐ EH&amp;S ☐ Consultant ☐ Other:</td>
</tr>
<tr>
<td>Pre-Work Approval Inspection</td>
<td>☐ EH&amp;S ☐ Consultant ☐ Other:</td>
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<tr>
<td>Daily Onsite Oversight</td>
<td>☐ PM ☐ EH&amp;S ☐ Consultant ☐ IOR ☐ Other:</td>
</tr>
<tr>
<td>Air Sampling</td>
<td>☐ EH&amp;S ☐ Consultant ☐ Other:</td>
</tr>
<tr>
<td>Type:</td>
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<tr>
<td>Frequency:</td>
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<tr>
<td>Demolition Inspection</td>
<td>☐ PM ☐ EH&amp;S ☐ Consultant ☐ IOR ☐ Other:</td>
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<tr>
<td>ICRA Downgrade</td>
<td>☐ PM ☐ EH&amp;S ☐ Consultant ☐ IOR ☐ Other:</td>
</tr>
<tr>
<td>Final Visual Approval Inspection</td>
<td>☐ PM ☐ EH&amp;S ☐ Consultant ☐ IOR ☐ Other:</td>
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<tr>
<td>ICRA #</td>
<td>Location</td>
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**Daily Inspection Log**

<table>
<thead>
<tr>
<th>Date &amp; Time</th>
<th>Performed by (Name)</th>
<th>Pressure Reading (+/-)</th>
<th>Acceptable Negative Pressure? (Y/N)</th>
<th>ILSM conditions still met? (Y/N)</th>
<th>Tack Mat useable? (Y/N)</th>
<th>Interior free of dust/debris? (Y/N)</th>
<th>Containment Integrity Intact (no holes or breaches)? (Y/N)</th>
<th>All ICRA permit conditions met? (Y/N)</th>
<th>Other Issues? (Explain)</th>
<th>Corrective Actions</th>
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<tr>
<td>Example 7/4/16 0800</td>
<td>B. Clean</td>
<td>-0.025</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>closed entry door</td>
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</table>
Caution

Construction Dust Precautions In Use
Do Not Enter

For More Information Contact the Project Manager

_____________________________________
(Name)

_____________________________________
Phone Number

This sign must be posted in color
PART I – PURPOSE

This section outlines policy and procedures for access to ceiling spaces containing or suspected of containing asbestos fireproofing, thermal insulation, or other asbestos containing material.

PART II – 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 fire proofing 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 III – PROCEDURES

A. Training

Personnel performing work in spaces containing or suspected of containing asbestos material shall have training which meets the requirements of Cal/OSHA Class III asbestos work that is specific to the work task to be completed.

B. Competent Person

During work in asbestos contaminated attic spaces, an asbestos Competent Person, as defined by 8 CCR 1529, shall be present at all times to oversee safe access and control measures. A Competent Person shall inspect the area to assure the controlled work area is properly established, and to determine that appropriate cleanup has occurred at the end of the work task.

C. Standard Access/Egress Procedures From Mini-enclosure

1. Access into an attic space with asbestos shall be completed using a manufactured mini-enclosure, or an equivalent enclosure constructed on site. Use of a small HEPA filtered negative air unit attached or integrated with the mini-enclosure to create negative pressure in the enclosure is required. A HEPA filtered vacuum shall be present and available for use in the mini-enclosure. The mini-enclosure must be posted with the asbestos warning sign in accordance with Cal/OSHA Title 8 CCR 8 1529. Access into the enclosure must be restricted to trained personnel, who are required to wear full body coveralls and a respirator approved for asbestos. A sticky mat shall be present immediately outside of the mini-enclosure. Any debris generated by work activity must be cleaned up using a HEPA vacuum and wet wiping techniques.

2. Disposable full body coveralls are required in all ICRA Class III and IV containment areas and shall be selected to provide protection of street clothes from particulates generated inside of the containment area. All work inside a mini-enclosure for asbestos related work is considered ICRA Class III or IV. Disposable coveralls shall be changed if they become ripped and are no longer serviceable.

3. Proper use of the disposable coveralls 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 mini-enclosure wearing soiled disposable coveralls and booties. At times, in select areas requiring sterile environments, it may be necessary to change from soiled disposable clothing into clean disposable clothing before exiting containment. Coveralls and booties are to be removed inside the mini-enclosure and placed into a plastic asbestos waste bag before leaving the mini-enclosure.

D. Air Sampling

Air sampling is required per 8 CCR 1529 to assess asbestos exposures when the project requires workers to enter the attic space. The air sampling frequency shall be sufficient to assess all work activities in the mini-enclosure and in the attic space and may include both 30 minute Excursion sample periods and longer sampling periods.

E. Debris Clean-up

All debris inside of the mini-enclosure shall be cleaned up promptly by HEPA vacuuming and wet wiping techniques and before each time the mini-enclosure is moved.

F. Personal Protective Equipment

All personnel entering the attic space with asbestos shall wear full body disposable coveralls (e.g., Tyvek, Kleenguard or equivalent) and a respirator with HEPA (P-100) filter cartridges for asbestos protection (or a respirator offering greater protection).

G. Entering ceiling spaces where asbestos fire proofing (contaminated with assumed or visible asbestos debris) is present (e.g., when personnel must enter the space and “crawl” in the attic space but no asbestos abatement work is planned).

1. Control of disturbance of asbestos debris during work inside of an attic space with asbestos debris shall be followed in all cases, by using a HEPA vacuum to clean-up visible suspect asbestos containing debris in the immediate area of access and work. If practical, vacuum visible debris for the full path of travel. If this is not practical, use other procedures to ensure safe removal of visible 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. The top surface of the attic access panel shall be cleaned of all dust and debris using a wet paper towel before the access hatch panel is allowed to swing down into the suspended position. 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 suspect asbestos containing debris
   - the control method must not result in a release of airborne fibers.

2. If the coverall tears or rips during the work activity, repair or replacement is required. Use duct tape to repair tears or rips to the coverall if feasible, or exit and replace the coverall. Remove and bag coverall in mini-enclosure as in ceiling access procedure. If coveralls were torn, vacuum any noticeable debris from underlying clothing. Use two disposable coveralls to minimize contamination of street clothes when tearing is likely or when crawling on rough surfaces.

H. HEPA Filter Challenge Testing and Certification
All HEPA filtered equipment (including negative air units and vacuums) used must have passed onsite DOP testing within the last 6 months and must be re-certified after filter replacement or if moved offsite, including to another UCDMC building.

I. Access for Inspection after Ceiling Tile has been Removed

Inspection above the ceiling, after a ceiling tile has been moved using a mini-enclosure containment, may be performed with asbestos awareness training. Access of this type is limited to visual inspection through the ceiling opening. Full entry to the space or ceiling crawl must meet the other requirements 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.

J. 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 label. Appropriate packaging includes double-bagging, and wetting the materials in the inner bag. Each bag shall be legibly marked with:

- The Generator: UC Davis Medical Center
- The Generator EPA ID No: CAD076124981
- The Generator address: 2315 Stockton Blvd., Sacramento, CA 95817

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 with at least one week’s notice of the intent to dispose. 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. Contact EH&S with at least one week’s notice of the intent to dispose.

END OF SECTION 01 56 02
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 01 35 00 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 contactors' 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. ICRA’s 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 pywood 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 location.
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 existing 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
### Project Title:
**Stair Tower and Corridor Upgrades – Increment 3**

### Project No.:
**9559040**

### Location:
Main Hospital East Wing Radiology Ground through 2nd Floors & East Wing Tower 3rd Floor through 8th Floor and East Wing Tower Roof.

A new 8 story stair tower affixed to the exterior of the East Wing. Stair tower work includes new rated Vestibules at each floor, exit pathways, demolition of (E) stair #4, repairs to (E) ramps, new 2 floor stair case, new toilet rooms, new sewage ejector pump and pump room, new mechanical units and ducting, new electrical branches & feeders.

### Summary for Scope of work:
- New 8 story stair tower affixed to the exterior of the East Wing.
- Stair tower work includes new rated Vestibules at each floor, exit pathways, demolition of (E) stair #4, repairs to (E) ramps, new 2 floor stair case, new toilet rooms, new sewage ejector pump and pump room, new mechanical units and ducting, new electrical branches & feeders.

### Step 1:
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  &lt;br&gt;Includes, but is not limited to:  &lt;br&gt;- removal of ceiling tiles for visual inspection only, e.g., limited to 1 tile per 50 square feet  &lt;br&gt;- painting (but not sanding)  &lt;br&gt;- wall covering, 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  &lt;br&gt;Includes, but is not limited to:  &lt;br&gt;- installation of telephone and computer cabling  &lt;br&gt;- access to chase spaces  &lt;br&gt;- 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  &lt;br&gt;Includes, but is not limited to:  &lt;br&gt;- sanding of walls for painting or wall covering  &lt;br&gt;- removal of floor coverings, ceiling tiles and casework  &lt;br&gt;- new wall construction  &lt;br&gt;- minor duct work or electrical work above ceilings  &lt;br&gt;- major cabling activities  &lt;br&gt;- any activity which cannot be completed within a single work shift</td>
</tr>
<tr>
<td><strong>Type D</strong></td>
<td>Major demolition and construction projects  &lt;br&gt;Includes, but is not limited to:  &lt;br&gt;- activities which require consecutive work shifts  &lt;br&gt;- requires heavy demolition or removal of a complete cabling system  &lt;br&gt;- new construction</td>
</tr>
</tbody>
</table>

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*Steps 1-3 Adapted with permission V. Kennedy, B. Barnard, St. Luke Episcopal Hospital, Houston, TX; C Fina CA<br>Steps 4-14 Adapted with permission Fairview University Medical Center Minneapolis, MN Forms modified updated; provided courtesy of Judene Bartley, ECSI Inc. Beverly Hills, MI 2002. Jbartley@ameritech.net – Updated, 2009.*
Step 2:
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>Office Areas</td>
<td>Cardiology</td>
<td>CCU</td>
<td>Any area caring for immunocompromised patients</td>
</tr>
<tr>
<td></td>
<td>Echocardiography</td>
<td>Emergency Room</td>
<td>Burn Unit</td>
</tr>
<tr>
<td></td>
<td>Endoscopy</td>
<td>Labor &amp; Delivery</td>
<td>Cardiac Cath Lab</td>
</tr>
<tr>
<td></td>
<td>Nuclear Medicine</td>
<td>Laboratories (specimen)</td>
<td>Central Sterile Supply</td>
</tr>
<tr>
<td></td>
<td>Physical Therapy</td>
<td>Medical Units</td>
<td>Intensive Care Units</td>
</tr>
<tr>
<td></td>
<td>Radiology/MRI</td>
<td>Newborn Nursery</td>
<td>Negative pressure isolation rooms</td>
</tr>
<tr>
<td></td>
<td>Respiratory Therapy</td>
<td>Outpatient Surgery</td>
<td>Oncology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pediatrics</td>
<td>Operating rooms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pharmacy</td>
<td>including C-section rooms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post Anesthesia Care Unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surgical Units</td>
<td></td>
</tr>
</tbody>
</table>

Step 2: High Risk (Varies from Low Risk to High Risk Maximum)

Step 3: 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, 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>Construction Project Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Risk Group</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>LOW Risk Group</td>
</tr>
<tr>
<td>MEDIUM Risk Group</td>
</tr>
<tr>
<td>HIGH Risk Group</td>
</tr>
<tr>
<td>HIGHEST Risk Group</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Type A</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>LOW Risk Group</td>
</tr>
<tr>
<td>MEDIUM Risk Group</td>
</tr>
<tr>
<td>HIGH Risk Group</td>
</tr>
<tr>
<td>HIGHEST Risk Group</td>
</tr>
</tbody>
</table>

Note: Infection Control Approval will be required when construction activity and risk level indicate the Class III or Class IV control procedures are necessary.

Step 3: IV

Steps 1-3 Adapted with permission V. Kennedy, B. Barnard, St. Luke Episcopal Hospital, Houston, TX; C Fine CA
Steps 4-14 Adapted with permission Fairview University Medical Center Minneapolis, MN Forms modified /updated; provided courtesy of Judene Bartley, ECSI Inc. Beverly Hills, MI 2002. Jbartley@amitech.net – Updated, 2009.
**DESCRIPTION OF REQUIRED INFECTION CONTROL PRECAUTIONS BY CLASS**

<table>
<thead>
<tr>
<th>Class</th>
<th>During Construction Project</th>
<th>Upon Completion of Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace a ceiling tile displaced for visual inspection.</td>
<td>1. Clean work area upon completion of task.</td>
</tr>
<tr>
<td>II</td>
<td>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.</td>
<td>1. Wipe work surfaces with cleaner/disinfectant. 2. Contain construction waste before transport in tightly covered containers. 3. Wet mop and vacuum with HEPA filtered vacuum before leaving work area. 4. Upon completion, restore HVAC system where work was performed.</td>
</tr>
<tr>
<td>III</td>
<td>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. 4. Contain construction waste before transport in tightly covered containers. 5. Cover transport receptacles or carts. Tape covering unless solid lid.</td>
<td>1. Do not remove barriers from work area until completed project is inspected by the owner’s Safety Department and Infection Prevention &amp; 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.</td>
</tr>
<tr>
<td>IV</td>
<td>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.</td>
<td>1. Do not remove barriers from work area until completed project is inspected by the owner’s Safety Department and Infection Prevention &amp; 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.</td>
</tr>
</tbody>
</table>

Steps 1-3 Adapted with permission V. Kennedy, B. Barnard, St. Luke Episcopal Hospital, Houston, TX; C Fine CA. Steps 4-14 Adapted with permission Fairview University Medical Center Minneapolis, MN. Forms modified/updated; provided courtesy of Judene Bartley, ECSI Inc. Beverly Hills, MI 2002. Jbartley@ameritech.net - Updated, 2009.
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.

Main Hospital East Wing Radiology Ground through 2nd Floors & East Wing Tower 3rd Floor through 8th Floor and East Wing Tower Roof.

Step 6: Identify issues related to: ventilation, plumbing, electrical in terms of the occurrence of probable outages.

HVAC, plumbing, electrical will all require planned outages.

Step 7: Identify containment measures, using prior assessment. What types of barriers? (e.g., solids wall barriers, etc.); Will HEPA filtration be required?

Critical barriers for containment and HEPA filtration will be required.

(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, etc.)

Contractor is required to provide spill kits and water leak drills to mitigate risk of water damage.

Step 9: Work hours: Can or will the work be done during non-patient care hours?

The majority of work will be performed during standard shift, and some after-hours work will be required.

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 hand washing sinks?

Yes. Locations to be determined.

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)

Review with EH&S & Epidemiology Department.

Step 13: Does the infection prevention & control staff agree with the plans relative to clean and soiled utility rooms?

Review with EH&S & Epidemiology Department.

Step 14: Plan to discuss the following containment issues with the project team, e.g., traffic flow, housekeeping, debris removal (how and when), etc.

THIS IS A SUMMARY ICRA & PERMIT. CONTRACTOR SHALL PROVIDE AND SUBMIT AN ICRA FOR EACH AREA THAT WILL BE UNDER CONTAINMENT. MULTIPLE CONTAINMENTS WILL BE REQUIRED.

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.

Steps 1-3 Adapted with permission V. Kennedy, B. Barnard, St. Luke Episcopal Hospital, Houston, TX; C. Fina CA

Steps 4-14 Adapted with permission Fairview University Medical Center Minneapolis, MN Forms modified/updated; provided courtesy of Judene Bartley, ECSI Inc. Beverly Hills, MI 2002. Jbartley@ameritech.net -- Updated, 2009.

01561 - 14
AIRBORNE CONTAMINANTS CONTROL
11-28-16
**Infection Control Construction Permit**

**Summary Permit – Submit ICRAs to Obtain Permits for Specific Areas**

<table>
<thead>
<tr>
<th>Location of Construction:</th>
<th>East Wing Radiology &amp; Tower – All Floors</th>
<th>Project Start Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Coordinator:</td>
<td></td>
<td>Estimated Duration:</td>
</tr>
<tr>
<td>Contractor Performing Work:</td>
<td></td>
<td>Permit Expiration Date:</td>
</tr>
<tr>
<td>Supervisor:</td>
<td></td>
<td>Telephone:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TYPE A: Inspection, non-invasive activity</th>
<th>GROUP 1: Low Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE B: Small scale, short duration, moderate to high levels</td>
<td>GROUP 2: Medium Risk</td>
</tr>
<tr>
<td>TYPE C: Activity generates moderate to high levels of dust, requires greater 1 work shift for completion</td>
<td>GROUP 3: Medium/High Risk</td>
</tr>
<tr>
<td>TYPE D: Major duration and construction activities requiring consecutive work shifts</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 displaced for visual inspection.
3. Minor Demolition or Remodeling.

**CLASS II**

1. Provides active means to prevent airborne dust from dispersing into atmosphere.
2. Dust wet work surfaces to prevent dust while cutting.
3. Seal unused doors with duct tape.
4. Block off and seal air vents.
5. Wipe surfaces with clean/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. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.
4. 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.
4. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.
5. Seal holes, pipes, conduits, and punctures appropriately.
6. 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 may wear cloth or paper coveralls that are removed each time they leave the work site.

**Additional Requirements:**

- Do not remove barriers from work area until complete project is checked by Infection Prevention & Control and thoroughly cleaned by Environmental Services.
- Vacuum work area with HEPA filtered vacuums.
- Wet mop with disinfectant. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction.
- Cover transport receptacles or carts. Tape covering. Upon completion, restore HVAC system where work was performed.

**EXCEPTIONS/AUCTIONS TO THIS PERMIT ARE NOTED BY ATTACHED MEMORANDUM.**

**Permit Requested By:**

**Place of Work:**

**Permit Authorized By:**

**Date:**

---

Steps 1-3 Adapted with permission V. Kennedy, B. Bynard, St Luke Episcopal Hospital, Houston, TX; C Free, CA

Steps 4-14 Adapted with permission Fairview University Medical Center Minneapolis, MN Forms modified updated; provided courtesy of Jadene Bartley, ECSI Inc. Beverly Hills, Mt 2002. Jbartley@ameritech.net Updated, 2009.

**AIRBORNE CONTAMINANTS CONTROL**

**11-28-16**
# UCDMC Construction Dust & Hazardous Materials Inspection Worksheet

<table>
<thead>
<tr>
<th>ICRA Permit Number:</th>
<th>ICRA Class:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job # and Name: 9559040 Stair Tower &amp; Corridor Upgrades – Increment 3</td>
<td>Project Manager:</td>
</tr>
<tr>
<td>Estimated Start:</td>
<td>Estimated Completion:</td>
</tr>
</tbody>
</table>

## ACKNOWLEDGEMENT OF HAZARDOUS MATERIALS

<table>
<thead>
<tr>
<th>Does the project contact hazardous materials (e.g., asbestos, lead, mold, PCBs, mercury)?</th>
<th>Yes / No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verified How: (e.g., hazmat survey, personal knowledge)</td>
<td></td>
</tr>
<tr>
<td>By Whom: (name &amp; department)</td>
<td></td>
</tr>
</tbody>
</table>

## CONTAINMENT STRATEGIES

<table>
<thead>
<tr>
<th>Enclosure Types: [check all that apply]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Containment (poly over all surfaces not in SOW)</td>
</tr>
<tr>
<td>Isolated Room – Critical Openings Only (seal doors, supply and return registers, etc)</td>
</tr>
<tr>
<td>Mini Containment Cube (only large enough for 1-2 people; aka pop up cube)</td>
</tr>
<tr>
<td>Shrouded Tool with HEPA filtered exhaust</td>
</tr>
<tr>
<td>Glove Box Containment with HEPA filtered exhaust</td>
</tr>
<tr>
<td>Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Negative Pressure Requirements: [check all that apply]</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.020&quot; wc at all times (24/7) as displayed on mounted manometer</td>
</tr>
<tr>
<td>Visual Verification of some negative room pressure throughout project as displayed on manometer</td>
</tr>
<tr>
<td>No negative room pressure required</td>
</tr>
<tr>
<td>Negative pressure in localized HEPA exhausted work area (e.g. shrouded tool, glove box)</td>
</tr>
<tr>
<td>Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Negative Pressure Equipment: [check all that apply]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onsite Challenge Testing (DOP or particle counting) prior to setup</td>
</tr>
<tr>
<td>Challenge Tested within last 6 months; Equipment has remained onsite at UCDMC</td>
</tr>
<tr>
<td>Single HEPA Unit; exhausted to: Yes / No</td>
</tr>
<tr>
<td>Two HEPA Units in Parallel; exhausted to: Yes / No</td>
</tr>
<tr>
<td>Other:</td>
</tr>
</tbody>
</table>

## Additional Containment Requirements: [check all that apply]

<table>
<thead>
<tr>
<th>Ante Room</th>
<th>Masonite Floor Protection</th>
<th>Protective Clothing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk off mats</td>
<td>Shoe Covers</td>
<td>Air Scrubber</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## VERIFICATION OF WORK

<table>
<thead>
<tr>
<th>Type(s) of Inspection Required</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEPA Equipment Verification</td>
<td>□ EH&amp;S □ Consultant □ Other:</td>
</tr>
<tr>
<td>Pre-Work Approval Inspection</td>
<td>□ EH&amp;S □ Consultant □ Other:</td>
</tr>
<tr>
<td>Daily Onsite Oversight</td>
<td>□ PM □ EH&amp;S □ Consultant □ IOR □ Other:</td>
</tr>
<tr>
<td>Air Sampling</td>
<td>□ EH&amp;S □ Consultant □ Other:</td>
</tr>
<tr>
<td>Type:</td>
<td></td>
</tr>
<tr>
<td>Frequency:</td>
<td></td>
</tr>
<tr>
<td>Demolition Inspection</td>
<td>□ PM □ EH&amp;S □ Consultant □ IOR □ Other:</td>
</tr>
<tr>
<td>ICRA Downgrade</td>
<td>□ PM □ EH&amp;S □ Consultant □ IOR □ Other:</td>
</tr>
<tr>
<td>Final Visual Approval Inspection</td>
<td>□ PM □ EH&amp;S □ Consultant □ IOR □ Other:</td>
</tr>
</tbody>
</table>

Appendix A Worksheet
01 56 00 Temporary Barriers, Enclosures and Controls
<table>
<thead>
<tr>
<th>ICRA #</th>
<th>Location</th>
<th>Set Up Date</th>
<th>Electrical Shop Inspection</th>
<th>Pre-Start Inspection Name, Date, Time</th>
<th>Post-Demo Inspection Name, Date, Time</th>
<th>Downgrade Inspection Name, Date, Time</th>
<th>Final Inspection Name, Date, Time</th>
<th>Take Down Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Daily Inspection Log

<table>
<thead>
<tr>
<th>Date &amp; Time</th>
<th>Performed by (Name)</th>
<th>Pressure Reading (+/-)</th>
<th>Acceptable Negative Pressure? (Y/N)</th>
<th>ILSM conditions still met? (Y/N/n/a)</th>
<th>Task Mat useable? (Y/N)</th>
<th>Interior free of dust/debris? (Y/N)</th>
<th>Containment Integrity intact (no holes or breaches)? (Y/N)</th>
<th>All ICRA permit conditions met? (Y/N)</th>
<th>Other Issues? (Explain)</th>
<th>Corrective Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example 7/4/16 0800</td>
<td>B. Clean</td>
<td>0.025</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>closed entry door</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Caution
Construction Dust Precautions In Use
Do Not Enter

For More Information Contact the Project Manager
(Name)
Phone Number

This sign must be posted in color
PART 1 - GENERAL

1.1 SCOPE OF WORK
   A. General: Provide all materials, equipment and labor necessary to furnish and install straw roll barriers, silt sacks, etc. to comply with CASQA best management practices. Reference CASQA website https://www.casqa.org/resources/bmp-handbooks

   The contracts shall comply with all local and state regulations regarding:
   1. Cut and fill operations
   2. Temporary stockpiles
   3. Vehicle and equipment storage, maintenance and fueling operations
   4. Concrete disposal
   5. Dust control
   6. Tracking of dirt, mud on off-site streets
   7. Pipe flushing

1.2 QUALITY ASSURANCE
   A. General: Comply with CASQA and governing codes and regulations.

1.3 SUBMITTALS
   A. Storm Water Pollution Prevention Plan: The Contractor shall submit a Storm Water Pollution Prevention Plan prior to beginning work on site. Project is less than 1 acre, and does not require an NOI however the Contractor shall include and comply with CASQA best management practices.

PART 2 - PRODUCTS

2.1 MATERIALS
   A. Straw Rolls: Shall be straw rolls bound with wire or nylon string.
   B. Silt Fence: Shall be Mirafi or approved.
   C. Silt Sacks: Shall be CSI Geoturf or equal.
   D. Tracking Control: Aggregate or Steel Grating

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Straw Rolls: Install per CASQA standards.
   B. Silt Fence: Install per CASQA standards.
   C. Silt Sacks: Install per CASQA standards.
   D. Tracking Control: Install per CASQA standards.
3.2 MAINTENANCE AND REMOVAL

A. General: Maintain and repair all erosion control facilities throughout the construction period. Remove silt build up at straw rolls as needed. Repair damage to earth slopes and banks.

B. Cleaning: Keep project site, and adjacent onsite and offsite areas clean of all dust, soil, and debris.

END OF SECTION 01 57 01
PRODUCT OPTIONS AND SUBSTITUTIONS

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 #: 9559040 OSHPD #: I140010-34-03

PROJECT NAME: Stair Tower and Corridor Upgrades – Increment 3

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 I - GENERAL

1.01 SECTION INCLUDES
A. Surveying and Field Engineering Services

1.02 RELATED SECTIONS
A. Section 01 45 00 – QUALITY CONTROL

1.03 REGISTRATION REQUIREMENT
A. Contractor shall employ civil engineers/land surveyors, which are registered and licensed in the state of California and acceptable to the University.

1.04 LINE AND GRADES
A. Contractor shall provide all construction survey work required for accurate location of the Work. Horizontal and vertical control for the Work shall be from project reference marks as shown on Contract Drawings. University’s decision will be final in all questions regarding proper location of work.

B. Contractor shall verify final configuration of project during demolition work. Minor adjustments of work to accommodate existing field conditions shall be responsibility of Contractor.

C. Replace control points that may be lost or destroyed, base requirements on original survey control, at no increase in the Contract Sum.

PART II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION

3.01 INSPECTION
A. Verify locations of survey control points prior to starting work. Promptly notify University’s Representative of any discrepancies discovered.

3.02 SURVEY REFERENCE POINTS
A. Protect survey control points prior to starting site work; preserve permanent reference points during construction. Make no changes without prior written notice to University’s Representative.

B. Promptly report loss or destruction of any reference point or relocation required to University’s Representative. Replace dislocated survey points based on original survey control.
3.03 SURVEY REQUIREMENTS

A. Establish minimum of three (3) permanent benchmarks on site, referenced to establish control points. Record locations, with horizontal and vertical data, on Project Record Documents.

B. Establish lines and levels, locate and lay out by instrumentation and similar appropriate means:

1. Site improvements, including pavements, stakes for grading, fill and topsoil placement, utility locations, slopes and invert elevations.

2. Grid or axis for structures.

3. Building foundation, column locations and ground floor elevations.

4. Controlling lines and levels required for mechanical and electrical work.

5. Verify layouts as Work proceeds to assure compliance with required lines, levels and tolerances.

C. Periodically certify layouts by same means.

3.04 RECORDS

A. Maintain complete and accurate log of all control and survey work as it progresses.

B. On completion of foundation walls and major site improvements, prepare certified survey showing all dimensions, locations, angles and elevations of construction.

END OF SECTION 01 72 00
PART I - GENERAL

1.01 SECTION INCLUDES

A. Requirements and limitations for cutting and patching Work.

1.02 RELATED SECTIONS

A. Section 01 11 00 – SUMMARY OF THE WORK
B. Section 01 31 00 – COORDINATION
C. Section 01 33 00 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
D. Section 01 56 01 – AIRBORNE CONTAMINANTS CONTROL
E. Section 01 61 00 – PRODUCT REQUIREMENTS
F. 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.

1.03 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.

1.04 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 the online Hazardous Conditions Permit form at http://www.ucdmc.ucdavis.edu/fire. 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. 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.

2. Contractor is responsible for notifying University of all apparent locations where suspect asbestos containing materials may be present or discovered during the course of the project, such as cement pipes or other insulated material, which may be a result of newly excavated materials below grade or after building systems are opened such as within wall, ceiling or subfloor spaces. When any such location is discovered by Contractor, information relating thereto shall be immediately communicated to University's Representative.

3. Where welding and cutting activity is required and suspect painted surfaces are present that will be impacted by the welding or cutting activity, the contractor shall request from the University's Representative information regarding laboratory analysis for lead or other hazardous metals in the painted metal components before any cutting or welding is performed. The contractor shall refer to Section 01 35 00 Special Procedures, 1.05 Hazardous Materials Procedures regarding materials impacted by welding and cutting activity.

4. Contractor shall then follow any and all instructions as indicated by University's Representative.

PART II - PRODUCTS

2.01 MATERIALS

A. Product substitution: For any proposed change in materials, submit request for substitution under provision of SECTION 01 61 00 – PRODUCT REQUIREMENTS.

PART III - EXECUTION
3.01 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.

3.02 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.

3.03 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.

3.04 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 00
# CORING / SAWCUTTING NOTIFICATION

**LOCATION:**

**A/C:** 9559040

**TITLE:** Stair Tower and Corridor Upgrades – Increment 3

**TRACKING NUMBER:**

(Provided by PO&M)

**OSHPD #:** I140010-34-03

**DATE:**

**TO:** UC DAVIS MEDICAL CENTER  
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

**FROM:**

**SCOPE:**

<table>
<thead>
<tr>
<th>HAS USA BEEN NOTIFIED?</th>
<th>☐ YES</th>
<th>☐ NO</th>
<th>When?</th>
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<td>By Whom?</td>
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<td>LOCATION OF WORK SHOWN ON ATTACHED SITE PLANS?</td>
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<td>Purpose:</td>
<td>____________________________</td>
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<td>DATE(S) CORING OR SAWCUTTING WILL TAKE PLACE:</td>
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<td>____________________________</td>
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**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 I - GENERAL

1.01 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.

1.02 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.

C. Section 01 56 01 Airborne Contaminants Control have procedures and practices that shall be implemented and followed by the Contractor for this project.

PART II - PRODUCTS

2.01 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.

2.02 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, a clean room sticky mat. Replace mats daily or as requested by University Representative.

PART III - EXECUTION

3.01 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 with sweeping compound or HEPA Vacuum 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.

3.02 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.

3.03 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.

3.04 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.

3.05 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.

3.06 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
PART I - GENERAL

1.01 SECTION INCLUDES
   A. Procedures for Starting Systems

1.02 RELATED SECTIONS
   A. Section 01 81 00 – PLUMBING/HVAC TESTING PROCEDURES
   B. Section 01 82 00 – DEMONSTRATION AND TRAINING

1.03 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.

1.04 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 II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION

3.01 INSPECTION
   A. Verify Project conditions comply with requirements for start-up.
   B. Verify status of Work meets requirements for starting equipment and systems.

3.02 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.

3.03 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 I - GENERAL

1.01 SECTION INCLUDES

A. Protection for Products Including University Provided Products, After Installation.
B. Protection of Existing Utilities and Interference.

1.02 RELATED SECTIONS

A. Section 01 31 00 – COORDINATION
B. Section 01 51 00 – TEMPORARY UTILITIES

1.03 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 II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION

3.01 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
PART I - GENERAL

1.01 SECTION INCLUDES

   A. Project Closeout Procedures
   B. Contract Closeout Procedures

1.02 RELATED SECTIONS

   A. Section 01 31 00 – COORDINATION
   B. Section 01 33 00 – 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

1.03 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.

1.04 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.

1.05 FINAL COMPLETION SUBMITALS

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.
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.

1.06 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.

1.07 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.

1.08 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 15 and 16 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 II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION – Not Applicable to this Section

END OF SECTION 01 77 00
PART I - GENERAL

1.01 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

1.02 RELATED SECTIONS

A. Section 01 31 00 – COORDINATION
B. Section 01 33 00 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
C. Administrative general requirements for submittals.
D. Section 01 45 00 – QUALITY CONTROL: Manufacturer’s tests and inspections as a condition of warranty.
E. Section 01 61 00 – PRODUCT REQUIREMENTS
F. Section 01 77 00 – CLOSEOUT PROCEDURES

1.03 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 81 00 – TESTING, ADJUSTING AND BALANCING 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 00 – 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 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.

1.04 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 61 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.

1.05 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 2 through 16 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 Submittal: 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.
1.06 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.

END OF SECTION 01 78 00
GUARANTEE

Project Name: Hospital Seismic Upgrades - Stair Tower and Corridor Upgrades North/South Wing Demo Make Ready – Increment 3

Project Location: 2315 Stockton Blvd. Sacramento, CA 95817

Project Number: 9559040

GUARANTEE FOR _________________________________ (the "Contract"),

(Specification SECTION and/or Contract No.)

between The Regents of the University of California ("University") and

_____________________________ ("Contractor").

(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: __________________________

01 78 00 - 9
CLOSEOUT SUBMITTALS
07/2014 Edition
REPORT OF WORK REQUIRED BY WARRANTY

To: Dave Brooks, University Representative
From:

On the date noted, the University identified the following work required under warranty:

Prepared by: ________________  ____________________  ____________________
(Print Name)  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 I - GENERAL

1.01 SECTION INCLUDES

A. Procedures for Adjusting and Balancing Systems

1.02 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. Section 15 89 00 – DUCTWORK: Testing.

D. Section 15 99 00 – PLUMBING/HVAC FINAL TESTING, ADJUSTING & BALANCE

E. General Conditions of the Contract: Inspections, tests and approvals required by governing authorities.

1.03 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.

1.04 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.
1.05 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.

1.06 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 II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION

3.01 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.

3.02 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>Leakage Class 6 at 3&quot;wc</td>
<td>Per SMACNA</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 81 00
SECTION 01 82 00
DEMONSTRATION AND TRAINING

PART I - GENERAL

1.01 SECTION INCLUDES

A. Procedures for Demonstration of Equipment Operation and Instruction of University Personnel.

1.02 RELATED SECTIONS

A. Section 01 78 00 – CLOSEOUT SUBMITTALS
B. Section 01 81 00 – PLUMBING/HVAC TESTING PROCEDURES

1.03 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.

1.04 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 II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION

3.01 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.

3.02 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 82 00
DIVISION 02
EXISTING CONDITIONS
SECTION 02 25 00

EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Available Information: Information relative to subsurface conditions is available in accordance with “Information Available to Bidders”.


1.2 SECTION INCLUDES

A. Temporary excavation support and protection systems.

1.3 RELATED SECTIONS

A. Division 31 - Earthwork section for excavation to sub-grade elevations indicated.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01.

B. Accurately record actual locations of capped utilities and subsurface obstructions.

1.5 PERFORMANCE REQUIREMENTS AND DESIGN CRITERIA

A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls, and of resisting soil and hydrostatic pressure, and superimposed and construction loads.

1.5.1 Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, registered in the state of California, using performance requirements and design criteria indicated.

2. Prevent surface water from entering excavations by grading, dikes, or other means.

3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.

4. Monitor vibrations, settlements, and movements of adjacent constructions.

B. Design Criteria

1. Design system for the lateral earth pressures designated in geotechnical report as the minimum standard. Increase surcharge loading as required to account for loads imposed by adjacent structures, heavy equipment, material stockpiles, and/or construction sequencing. Loads to the existing footings are as provided by the structural engineer of record.

2. Limit lateral movement of shoring wall as required to prevent damage to adjacent buildings and improvements intended to remain.

1.6 PROHIBITED SYSTEMS
A. Shoring systems that employ vibration to install, including but not necessarily limited to sheet piling.

1.7 SUBMITTALS

A. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data, signed and sealed by the qualified professional engineer, licensed in the State of California, responsible for their preparation.

B. Qualifications: Submit the following as evidence of Excavation Support and Protection System Contractor's and Designer's experience:
   1. Contractor: List of projects covering a 10-year period with names and telephone numbers of contact persons to serve as references on each project.
   2. Designer: List of projects covering a 5-year period with names and telephone numbers of contact persons to serve as references on each project.

C. Shop Drawings: For excavation support and protection system.
   1. Indicate elements of Excavation Support and Protective System including material types and grades.
   2. Provide scaled drawings showing plan location of Excavation Support system. Indicate top and bottom elevations of excavation support elements, including lagging, steel plate, and piles.
   3. Indicate plan location, elevation, depth of embedment, and inclination of tie-backs or other lateral restraining elements.
   4. Indicate plan location of elements of Protective System.
   5. Indicate connection and attachment methods of Protective System.

D. Other Informational Submittals:
   1. Photographs: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems. Submit to University before Work begins.

1.8 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project Site.
   1. Schedule: Ten business days minimum prior to installation of Excavation Support and Protection System.
   3. Review methods and procedures related to Excavation Support and Protection system including, but not limited to, the following:
      a. Existing utilities and subsurface condition.
      b. Proposed excavations.
      c. Proposed equipment.
      d. Monitoring of excavation support and protection system.
      e. Working area location and stability.
      f. Removal of excavation support and protection system.
1.9 PROJECT CONDITIONS

A. Project Site Information: A geotechnical report has been prepared for this project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, test, and results of analyses conducted by geotechnical engineer. University will not be responsible for interpretations or conclusions drawn from the data.

1. Make additional test borings and conduct other exploratory operations necessary for excavation support.

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During installation of excavation support, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and position for comparison with original elevations and positions. Promptly notify University Representative if changes in elevation or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 PRODUCTS

2.1 GENERAL

A. Contractor to supply all products as required for the installation of Excavation Support and Protection System.

B. Products containing harmful chemicals or materials, including but not limited to wood preservatives, are prohibited.

C. Products must comply with governing air quality board requirements.

PART 3 EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operation.

1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to insure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from University Representative and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Locate Excavation Support and Protection Systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.

D. Mark location of utilities.
3.2 INSTALLATION

A. General

1. Coordinate installation of Excavation Support and Protection System with site excavation.

2. Monitor Excavation Support and Protection Systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

3. Promptly repair damages to adjacent facilities caused by installing Excavation Support and Protection Systems.

4. Meet system element requirements. System element requirements are intended for use where contractor selects system type and are not intended as direction to use noted system. Selection of Excavation Support and Protection System is solely that of the Contractor.

B. System Elements

1. Soldier Piles, Wood Lagging, Steel Plate
   a. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges.
   b. Install wood lagging and/or steel plate within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging.

2. Tiebacks
   a. Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
      1) Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protections system.
      2) Maintain tiebacks in place until permanent construction is able to withstand lateral soil and hydrostatic pressures.

3. Bracing
   a. Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
      1) Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by University Representative.
      2) Install internal bracing, if required, to prevent spreading or distortion of braced frames.
      3) Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.3 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

1. Completely remove all elements of excavation support and protection systems from site.
   a. Inert aggregate fill placed around soldier piles in lieu of lean concrete may be left in place.

2. Fill voids immediately with approved backfill compacted to density specified in Division 31,
“Earthwork”.

3. Repair or replace, as approved by University Representative, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Remove temporary Work.

END OF SECTION 02 25 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 A/C 9559040, North/South Wing Demo Make Ready – Increment 3, 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 the fabrication and installation of an 8 story stair tower affixed to the exterior of an existing structure. Included in the work are new rated vestibules at each floor, exit pathways, demolition of exiting stairs, repairs to ramps. Connection to the existing building will impact asbestos containing materials and will impact components with lead in the paint. 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.

2. The East Wing has 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.

3. Asbestos Abatement Overview – This project will include removal of asbestos containing fireproofing materials in locations where the new stair towers will be connected on each floor of the East Wing and in other locations. For this project there are two distinct conditions of work involving asbestos. 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, since the asbestos would be removed with 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.

4. In 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 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.

5. The project will include access into the attic space to conduct the work required. In addition to removal of fireproofing in large areas for the stairwell connections, there may be small amounts of the fireproofing required to be removed for anchoring seismic braces and other attachments. 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.

6. 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.

7. 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 East Wing is 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.

8. Work practices and procedures for asbestos removal are provided in these specifications.

9. In locations where there has been removal of spot areas of asbestos fireproofing for attachments, the asbestos contractor will be responsible for replacement of the fireproofing materials to maintain fire rated assemblies. The new fireproofing materials shall be hand packed by the asbestos contractor or by a contractor with asbestos training. In locations where large areas of fireproofing have been removed, spray application of new fireproofing will be required. See other specifications regarding materials, execution and performances for this required work.

9. 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

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 and replaced or impacted.

### Table A. Asbestos Containing Materials in East Wing

<table>
<thead>
<tr>
<th>Building System Description</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>3-15%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Pipe Insulation and Fittings (Elbow) with Hand Packed Insulation</td>
<td>RACM</td>
<td>I</td>
<td>5-20%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Drywall and Joint Compound</td>
<td>RACM</td>
<td>I</td>
<td>Assumed &gt; 1%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Wall Plaster Cavities</td>
<td>RACM</td>
<td>I</td>
<td>Assumed &gt; 1%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Ceiling Plaster Spaces</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>Resilient Sheet Flooring (Pebble Pattern) and Mastic</td>
<td>RACM</td>
<td>I</td>
<td>40%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Electrical Wiring contaminated</td>
<td>Cat II</td>
<td>II</td>
<td>Assumed &gt; 1%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Piping and Conduit 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” and 12” Floor Tiles &amp; Mastic</td>
<td>Cat I</td>
<td>II</td>
<td>5-30% in both Tile and Mastic</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Transite Pipes</td>
<td>Cat II</td>
<td>II</td>
<td>Assumed &gt; 1%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Transite Material Sandwiched between Metal Ventilator Units at Perimeter Walls of Patient Rooms</td>
<td>Cat II</td>
<td>II</td>
<td>Assumed &gt; 1%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Caulking at Horizontal Base of Exterior Pre-Cast Aggregate Wall Panels</td>
<td>Cat II</td>
<td>II</td>
<td>1-5%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Exterior Stucco</td>
<td>Cat II</td>
<td>II</td>
<td>&lt; 1%</td>
<td>See Drawings</td>
</tr>
<tr>
<td>Dark Gray Colored Woven Electrical Wiring</td>
<td>Cat II</td>
<td>II</td>
<td>40-50%</td>
<td>Electrical panels in Dumbwaiter Penthouse</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 is attached as an Appendix A to 02 82 00. This inspection report 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 and on September 15, 2017 are attached as Appendix B. The contractor shall refer to all inspection reports for locations were asbestos has been identified in the East Wing.

2. Where “See Drawings” is noted in the above table or elsewhere in this specification; reference drawings identified in the Sheet Index for Location.

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>
<thead>
<tr>
<th>Material Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustic Ceiling Panels (2’x2” and 2’x3”)*</td>
<td>Various Locations</td>
</tr>
<tr>
<td>Acoustic Ceiling Tiles (12”x12”) with Mastic*</td>
<td>Various Locations</td>
</tr>
<tr>
<td>Base Cove Mastic (4” and 6”)</td>
<td>Various Locations</td>
</tr>
<tr>
<td>Window Putty (Glazing)</td>
<td>Various Locations</td>
</tr>
<tr>
<td>Sink Undercoat (Black)</td>
<td>Various Locations</td>
</tr>
<tr>
<td>Plaster Walls* and Plaster Ceilings*</td>
<td>Various Locations</td>
</tr>
<tr>
<td>White and Black Caulking Between Exterior Pre-cast Aggregate Concrete Wall Panels</td>
<td>Exterior Walls</td>
</tr>
<tr>
<td>Gray Caulking Between Exterior Pre-cast Smooth Concrete Wall Panels</td>
<td>Exterior Walls</td>
</tr>
<tr>
<td>Terrazzo Flooring</td>
<td>Various Locations</td>
</tr>
<tr>
<td>Ventilation Duct Seam Tape</td>
<td>Various Locations</td>
</tr>
<tr>
<td>Concrete</td>
<td>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</td>
</tr>
</tbody>
</table>
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.

2. Where “See Drawings” is noted in the above table or elsewhere in this specification; reference drawings identified in the Sheet Index for Location.

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 bag.

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 8 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
   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
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 onsite 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 UCDMC. 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, not -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/exist 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 zippered 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 zippered 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 zippered door. 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 anteroom 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/exiting 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.
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 andJoint 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) Slit 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 III

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 personal 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 the 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 of 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. Refer to the report MACTEC Engineering and Consulting, Inc. November 29, 2005 for the lead in paint inspection conducted in the East Wing. 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 is attached as an Appendix A to 02 82 00 and to Section 02 83 00. This inspection report includes an assessment for hazardous materials including asbestos, lead in paint, fluorescent light tubes and ballasts containing PCB’s. The contractor shall refer to this inspection report for locations were lead in paint has been identified in the East Wing.
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; reference drawings identified in the sheet index for Location.

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 µg/M³ 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>Deciliter</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>
<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
</tbody>
</table>
FVC  Forced Vital Capacity
FEV  Forced Expiratory Volume
GFCl  Ground Fault Circuit Interrupter
HEPA  High Efficiency Particulate Air
HUD  U.S. Department of Housing and Urban Development
HVAC  Heating, Ventilation, and Air Conditioning
ICRA  Infection Control Risk Assessment
INTERIM CONTROLS  Removal at specific locations to accommodate remodel < 20 years
LBP  Lead Based Paint (paints, varnish, shellac, etc. >0.5% lead by weight, >5,000 ppm, or > 1.0 mg/cm²)
LCM  Lead Containing Material – materials tested to contain any measurable levels of lead
µg  Microgram = part per billion (ppb)
SDS  Safety Data Sheet
NAAQS  National Ambient Air Quality Standards
NAM  Negative Air Machine
NESHAP  National Emissions Standard for Hazardous Air Pollutants
NFPA  National Fire Protection Association
NPE  Negative Pressure Enclosure
NVLAP  National Voluntary Laboratory Accreditation Program
O&M  Operations and Maintenance
OSHA  Federal Occupational Safety and Health Administration
PEL  Permissible Exposure Limit (50 µg/M³ 8 hr. TWA)
PLCM  Presumed Lead Containing Material
PPE  Personal Protective Equipment
RCRA  Resource Conservation and Recovery Act
TCLP  Toxicity Characteristic Leaching Procedure (mg/L)
TTLC  Total Threshold Limit Concentration (wet-weight mg/kg)
TSP  Trisodium Phosphate
TWA  Time Weighted Average
STLC  Soluble Threshold Limit Concentration (mg/L)
UCDHS  UC Davis Health System
ULPA  Ultra Low Penetrating Air
XRF  X-ray Fluorescence
ZPP  Zinc Protoporphyrin

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 IHLAP 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 13280.

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 1.4I)

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-containement 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 uncontained 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 µg/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. Reviewing the 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
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 \( \geq 1,000 \) mg/kg is considered a hazardous waste.
      b. TTLC with a result of \( \geq 50 \) mg/kg of lead must be retested using STLC method.
      c. A STLC result of \( \geq 5.0 \) mg/l must be retested using TCLP.
      d. A TCLP result of \( \geq 5.0 \) mg/l deems the waste Federal RCRA.
      e. A STLC of \( \geq 5 \) 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 \( \geq 1,000 \) mg/kg and the soluble threshold concentration (STLC) for lead is \( \geq 5 \) 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 landfill. 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:
   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
DIVISION 03
CONCRETE
SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART I - GENERAL

1.01 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.

1.02 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.

1.03 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.
      2. Concrete strength shall be based on ACI 318, Chapter 5.
   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. Fiber reinforcement
5. Admixtures
6. Waterstops
7. Curing materials
8. Floor and slab treatments
9. Bonding agents
10. Adhesives
11. Vapor retarders
12. Epoxy joint filler
13. Joint-filler strips
14. Repair materials

1.04 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."
3. ACI 302-2R-06, "Guide to Concrete Slabs that Receive Moisture Sensitive Flooring 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.

1.05 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 II - PRODUCTS

2.01 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. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, ¾” x ¾”, minimum.

G. 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.

H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that will leave no corrodible metal closer than 1” to the plane of the exposed concrete surface.
   2. Furnish ties that, when removed, will leave holes not larger than 1” in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.02 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.

2.03 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.

2.04 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.

D. Fly Ash: CBC 1903A.5, Class F

2.05 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.

2.06 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
   1. Profile: Flat, dumbbell with center bulb.

B. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
   1. Profile: Flat, dumbbell with center bulb.

C. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, sodium bentonite or other hydrophylic material for adhesive bonding to concrete.

2.07 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 15 mils (0.25 mm) thick:
   1. Nonwoven, polyester-reinforced, polyethylene coated sheet; 15 mils (0.25 mm) thick.
   2. Three-ply, nylon or polyester-cord-reinforced, laminated, high-density polyethylene sheet; 15 mils (0.18 mm) thick.
B. Fine-Graded Granular Material: Clean mixture of crushed stone or crushed gravel; 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.

2.08 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50% aluminum oxide and not less than 25% ferric oxide; unaffected by freezing, moisture, and cleaning materials.

B. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

C. Penetrating Liquid Floor Treatment – Exterior: Chemically reactive, waterborne solution of inorganic silicate or silonate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.

2.09 CURING MATERIALS – EXTERIOR CONCRETE

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.

E. Curing Compounds containing Silicates are acceptable for bare or exterior concrete but not in areas to receive any type of flooring materials.

2.10 CURING MATERIALS – INTERIOR CONCRETE

A. No curing compound containing Silicates will be allowed on any interior project.

B. Known curing compounds not containing silicates are;
   a. Type I Class B. Wr Meadows Vocom 25
      i. Contains 25% acrylic
      ii. Must Comply with ASTM – F1315

C. Curing compound shall be compatible with floor finishes.

2.11 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.

F. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch-thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from ¼” 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, ⅝ to ¼” 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.

2.13 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.
   1. Maximum Slump: 4" (125 mm).

   1. Maximum Slump: 4" (125 mm).
   2. Weight: 110 pcf.

2.14 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.15 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 90ºF, reduce mixing and delivery time from 1-½ hours to 75 minutes; when air temperature is above 90ºF, reduce mixing and delivery time to 60 minutes.

PART III - EXECUTION

3.01 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, ½".
   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.

### 3.02 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.

### 3.03 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.

3.04 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.

3.05 VAPOR RETARDERS

A. Fine-Graded Granular Material: Provide sand under vapor retarder, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus ¾” (19 mm).

B. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer’s written instructions.

C. Pour Concrete directly on Vapor Barrier.

3.06 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.

3.07 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: Discontinue reinforcing steel at 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.
3.08 WATERSTOPS

A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place. Install in longest lengths practicable.

3.09 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. Slope surfaces uniformly to drains where required.
5. 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.

3.10 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 1/8” 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.

3.11 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 thickest 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.

G. Slip-Resistive Aggregate Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.

2. After broadcasting and tamping, apply float finish.

3. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose slip-resistive aggregate.

3.12 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.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.13 CONCRETE PROTECTION AND CURING – EXTERIOR

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.

3.14 CONCRETE PROTECTION AND CURING – INTERIOR

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 within three hours after initial application. Maintain continuity of coating and repair damage during curing period. Curing Compound cannot have any Silicates.

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 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. Curing and Sealing Compound cannot have any Silicates.

3.15 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.

3.16 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.

3.17 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: Samples for strength test of each class of concrete placed each day; or not less than once for each 50 cubic yards of concrete; or not less than once for each 2,000 square feet of surface area for slabs or walls. Additional samples for seven day compressive strength tests shall be taken for each class of concrete at the beginning of the concrete work or whenever the mix or aggregate is changed. 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.

2. 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.

3. 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.

4. 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.

5. 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
NOT USED
DIVISION 05
METALS
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. Steel Pipe: ASTM A 53, Type E or S, Grade B.

1. Weight Class: Standard.

2. Finish: Black.


F. Shear Connectors: ASTM A 108, Grade 1015 through 1020, headed-stud type, cold-finished carbon steel, AWS D1.1, Type B.

G. 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.


H. 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.
I. 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.

J. 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.

K. 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

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.
A/C 9559040
Hospital Seismic Upgrade – Increment 3
North/South Wing Demo Make Ready

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
PART I - GENERAL

1.01 DESCRIPTION

A. Scope: Work of this Section shall include all materials and installation necessary to provide all cold formed metal framing.

B. This Section includes: (sheetmetal) as shown and detailed:

1. Exterior load-bearing wall framing
2. Interior load-bearing wall framing
3. Exterior non-load-bearing curtain-wall framing
4. Floor joist framing
5. Roof trusses
6. Roof rafter framing
7. Ceiling joist framing

As shown and detailed on the Drawings and specified herein.

C. Related Sections include the following:

1. Section 09 22 16 – Metal Stud System for interior non-load-bearing metal-stud framing and ceiling-suspension assemblies.

1.02 DEFINITIONS

A. Minimum Uncoated Steel Thickness: Minimum uncoated thickness of cold-formed framing delivered to the Project site shall be not less than 95% of the thickness used in the cold-formed framing design. Lesser thicknesses shall be permitted at bends due to cold forming.

B. Producer: Entity that produces steel sheet coil fabricated into cold-formed members.

1.03 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining Work.
C. Mill certificates signed by steel sheet producer or test reports from a qualified independent testing agency indicating steel sheet complies with requirements.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

E. Product Test/Evaluation Reports: From a qualified testing agency, such as the International Code Council (ICC), indicating that each of the following complies with requirements, based on comprehensive testing of current products in accordance with the current building code:

1. Expansion anchors.
2. Power-actuated anchors.
3. Mechanical fasteners.
4. Vertical deflection clips.
5. Miscellaneous structural clips and accessories.

1.04 QUALITY ASSURANCE

A. Mill certificates signed by steel sheet producer or test reports from a qualified independent testing agency indicating steel sheet complies with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and galvanized-coating thickness.

B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.


D. Fire-Test-Response Characteristics: Where metal framing is part of a fire-resistance-rated assembly, provide framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.


E. AISI Specifications: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members" or "Load and Resistance Factor Design Specification for Cold-Formed Steel Structural Members" and the following for calculating structural characteristics of cold-formed metal framing.


F. VOC compliance certificate signed by manufacturers certifying compliance of their products with regulations of authorities having jurisdiction over volatile organic compounds (VOCs).
1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART II - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers shall be certified Steel Stud Manufacturers Association (SSMA) members.

2.02 MATERIALS

A. Steel Sheet: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: 33 or 50, as indicated on Drawings.
   2. Coating: G60 (Z180).

2.03 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123.

B. Anchor Bolts: As indicated on Drawings.

C. Expansion Anchors: Hilti KB-TZ, Simpson Strong-Bolt, or equal with current ICC ES report.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated with current ICC ES report.

E. Mechanical Fasteners: Corrosion-resistant-coated, self-drilling, self-threading steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.04 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20.

B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

2.05 GYPSUM SHEATHING
A. Sheathing: Comply with requirements in Section 09 29 00 – Gypsum Board.

2.06 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.

2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
   a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of \( \frac{1}{8} \) in 10' (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus \( \frac{1}{8} \) (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of \( \frac{1}{8} \) (3 mm).

PART III - EXECUTION

3.01 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistant materials.
B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

### 3.03 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to ASTM C 1007, unless more stringent requirements are indicated.

C. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.

1. Cut framing members by sawing or shearing; do not torch cut.

2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
   
   a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   
   b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

D. Install framing members in one-piece lengths, unless splice connections are indicated for track or tension members.

E. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

G. Install insulation in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings that are inaccessible on completion of framing work.

H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

I. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of $\frac{1}{8}$" in 10' (1:960) and as follows:

1. Space individual framing members no more than plus or minus $\frac{1}{4}$" (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
3.04 NON-LOAD-BEARING CURTAIN-WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

E. Install horizontal bridging in curtain-wall studs, spaced in rows indicated on Shop Drawings but not more than 54" (1370 mm) apart. Fasten at each stud intersection.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain-wall-framing system.

3.05 JOIST INSTALLATION

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
   1. Install joists over supporting frame with a minimum end bearing of 1-½" (38 mm).
   2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.

C. Space joists not more than 2" (51 mm) from abutting walls, and as follows:
   1. Joist Spacing: As indicated.

D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated.
   1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at each end of joists and at intervals indicated.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.06 FIELD QUALITY CONTROL

A. Testing: University shall engage a qualified independent testing agency to perform field quality-control testing.

B. Field and shop welds shall be subject to inspection and testing.

C. Testing agency shall report test results promptly and in writing to Contractor and University's Representative.

D. Remove and replace Work that does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of corrected Work with specified requirements.

3.07 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: Wire brush, clean, and paint scarred areas, welds, and rust spots on fabricated and installed prime-painted, cold-formed metal framing. Paint framing surfaces with same type of shop paint used on adjacent surfaces.

C. Protect paper-surfaced gypsum sheathing that will be exposed to weather for more than 30 days by covering exposed exterior surface of sheathing with a securely fastened air-infiltration barrier. Apply covering immediately after sheathing is installed.

D. Protect cutouts, corners, and joints in sheathing by filling with a flexible sealant or by applying tape recommended by sheathing manufacturer at time sheathing is applied.

E. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00
PART I - GENERAL

1.01 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 29 00 – GYPSUM BOARD

1.02 SUBMITTALS

A. General: Refer to Section 01 33 00 – SHOP DRAWINGS, PRODUCT DATA & SAMPLES.

B. Product Data: Submit manufacturer's specification, data, and installation instructions

1.03 PRODUCT HANDLING

A. General: Refer to Section 01 31 00 – COORDINATION.

1.04 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 II - PRODUCTS

2.01 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) #3064P.

2. Metal Studs: ASTM C645, non-load bearing type with punched webs; roll-formed electro-galvanized steel sheet in the following gages:

   16ga typical framing (OSHPD projects) 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-\(\frac{3}{4}\)" x \(\frac{3}{8}\)" deep with \(\frac{1}{2}\)" wide flanges.
   b) Zee: 1-\(\frac{1}{2}\)" x 1-\(\frac{1}{2}\)".
   c) 25ga electro-galvanized sheet, roll-formed. Resilient RC channels.

2. Floor runners or C-Track: 16ga Un-punched track (for OSHPD projects).
3. Top Runner or Slotted Track: 16ga deep leg punched track (for OSHPD projects).
4. Stud Stiffeners: 3\(\frac{1}{4}\)" cold rolled steel weighing not less than 300 lbs. per 1000 lineal feet; rust-inhibitive coated.
5. Channels: 2-\(\frac{1}{2}\)" 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 \(\frac{1}{8}\)", unless otherwise shown.

PART III - EXECUTION

3.01 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.

3.02 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 intermittently; 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.

D. Suspended Gypsum Board Ceilings and Soffits:
   1. General: Install for gypsum wallboard ceilings. Where ductwork or other obstructions prohibit use of specified system, provide heavier system per referenced Standard.
   2. Hanger Wires: Space at 48" on center both ways; do not support more than 16 square feet of ceiling per wire. Locate a hanger within 6" of end of main runners.
   3. Runner Channels: Space not over 48" on center; wrap each hanger wire twice around runner channel.
   4. Furring Channels: Attach to runner channels at 16" on center with snap-on clips, wire, or other acceptable methods.
   5. Openings: Reinforce as required for support of mechanical and electrical fixtures.
   6. Seismic Restraint: As shown on drawings.
3.03 CLEANING

A. See Section 01 74 00 – CLEANING.

END OF SECTION 05 41 00
PART I - GENERAL

1.01 DESCRIPTION:

A. Scope: Work under this Section shall include all material and installation necessary to provide Miscellaneous Metal Fabrications, as shown and detailed on the drawing and specified herein.

B. Related Work Specified Elsewhere:

1. Section 05 12 00 – Structural Steel

1.02 QUALITY ASSURANCE

A. References:

1. 2013 California Building Code (CBC)
5. Steel Structures Painting Council (SSPC): Painting Manual

B. QUALIFICATIONS:

1. General: Fabricator and installer specializing in the work of this Section with minimum three (3) years documented experience.

2. Welding: Performed by certified welders per AWS

1.03 SUBMITTALS

A. General: Refer to Section 01 33 00 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Shop Drawings: Submit manufacture and installation details, including fastenings.

C. Product Data: None required for specified products; required for alternate products.

D. VOC compliance certificate signed by manufacturers certifying compliance of their products with regulations of authorities having jurisdiction over volatile organic compounds (VOCs).

1.04 PRODUCT HANDLING

A. General: Refer to Section 01 31 00 – COORDINATION
B. Items Requiring Anchorage in Concrete: Deliver with complete setting diagrams, measurements, ICC evaluation reports, and manufacturer's written instructions.

1.05 GUARANTEE

A. General: Refer to Section 01 77 00 – CONTRACT CLOSEOUT.

B. Period: Provide in required form for a period of one (1) year from the date of final acceptance by the University’s Representative.

PART II - PRODUCTS

2.01 MATERIALS

A. Steel Shapes:
   1. General: ASTM A36 except ASTM A992 for wide-flange shapes
   2. Steel Tubing: ASTM A500, Grade B
   3. Steel Pipe: ASTM A53, Grade B

B. Fastenings:
   1. General: Bolts, nuts, screws, washers, and other various fastenings necessary for proper erection of work. Galvanized steel fastenings or other non-rusting types for exterior steel work.
   2. Exposed in Finished Surfaces: Tamperproof countersunk Phillips flat head screws, unless otherwise shown; finish to match adjacent surfaces.
   3. Plastic Screw Anchors:
      a. Type HUD, manufactured by Hilti, Inc.
      b. Star Anchors and Specialty Fasteners, Inc., or equal.

C. Post-installed Anchors:
   1. Except where indicated on the drawings, post-installed anchors shall consist of the following anchor types as provided by Hilti, Inc. or approved equal.
      a. Anchorage to concrete
         i) Adhesive anchors for cracked/uncracked concrete use:
            1) Hilti HIT-HY 200 Safe Set System with HILTI HIT-Z rod per ICC ESR-3187
            2) Hilti HIT-HY 200 Safe Set System with HILTI Hollow Drill Bit System with threaded rod per ICC ESR-3187.
            3) Hilti HIT-RE 500-SD Epoxy Adhesive Anchoring System with threaded rod per ICC ESR-2322 for slow cure applications
            4) ITW Red Head EPCON G5 per ICC-ESR 1137
            5) Powers PE 1000 per ICC-ESR 2583
ii) Medium duty mechanical anchors for cracked/uncracked concrete

1) Hilti KWIK HUS EZ and KWIK HUS EZ-I screw anchors per ICC ESR-3027
2) Hilti KWIK BOLT-TZ expansion anchors per ICC ESR-1917
3) ITW Red Head PER ICC-ESR 2427
4) Powers Power-Stud SD2 per ICC-ESR 2502

iii) Heavy duty mechanical anchors for cracked concrete use

1) Hilti HDA undercut anchors per ICC ESR 1546
2) Hilti HSL-3 expansion anchors per ICC ESR 1545
3) USP DUC undercut anchors per ICC ESR 1970

b) Rebar doweling into concrete

i) Adhesive anchors for cracked concrete use

1) Hilti HIT-HY 200 Safe Set System with Hilti Hollow Drill Bit System with continuously deformed rebar per ICC ESR-3187.
2) Hilti HIT-RE 500-SD Epoxy Adhesive Anchoring System with continuously deformed rebar per ICC ESR-2322.
3) ITW Red Head EPCON G5 per ICC-ESR 1137
4) Powers PE 1000 per ICC-ESR 2583

c) Anchorage to solid grouted masonry

i) Adhesive anchors use

1) Hilti HIT-HY 70 Masonry Adhesive Anchoring System per ICC-ESR 3342
2) Steel anchor element shall be Hilti HAS-E continuously threaded rod or continuously deformed steel rebar
3) Simpson Acrylic Tie Adhesive Anchor System per ICC-ESR 1958
4) Powers T 38+ Epoxy per ICC-ESR 3149

ii) Mechanical anchors use

1) Hilti KWIK BOLT-3 Expansion Anchors per ICC ESR 1385
2) Hilti KWIK-HUS EZ Screw Anchors per ICC-ESR 3056
3) Simpson Titen Screw Anchors per ICC-ESR 1056
4) Powers Wedge Bolt per ICC-ESR 1678

d) Anchorage to hollow/multi-wythe masonry

i) Adhesive anchors use

1) Hilti HIT-HY 70 Masonry Adhesive Anchoring System per ICC ESR-3342.
2) Steel anchor element shall be Hilti HAS-E continuously threaded rod or continuously deformed steel rebar.
3) The appropriate size screen tube shall be used per adhesive manufacturer’s recommendation.
4) Simpson Acrylic Tie Adhesive Anchor per ICC-ESR 1958
2) Anchor capacity used in design shall be based on the technical data published by the manufacturer or such other method as approved by the Structural Engineer of Record. Substitution requests for alternate products must be approved in writing by the Structural Engineer of Record prior to use. Contractor shall provide calculations demonstrating that the substituted product is capable of achieving the performance values of the specified product. Substitutions will be evaluated by their having an ICC ESR showing compliance with the relevant building code for seismic uses, load resistance, installation category, and availability of comprehensive installation instructions. Adhesive anchor evaluation will also consider creep, in-service temperature and installation temperature.

3) Install anchors per the manufacturer instructions, as included in the anchor packaging.

4) Overhead adhesive anchors must follow manufacturer’s printed installation procedures.

5) The contractor shall arrange an anchor manufacturer’s representative to provide onsite installation training for all of their anchoring products specified. The Structural Engineer of Record must receive documented confirmation that all of the contractor’s personnel who install anchors are trained prior to the commencement of installing anchors.

6) Anchor capacity is dependent upon spacing between adjacent anchors and proximity of anchors to edge of concrete. Install anchors in accordance with spacing and edge clearances indicated on the drawings.

7) Existing reinforcing bars in the concrete structure may conflict with specific anchor locations. Unless noted on the drawings that the bars can be cut, the contractor shall review the existing structural drawings and shall undertake to locate the position of the reinforcing bars at the locations of the concrete anchors, by Hilti Ferroscan, GPR, X-Ray, chipping or other means.

D. Non-Shrink Grout:

1. "Embco" manufactured by BASF Corporation

2. W.R. Meadows, Inc, or equal.

E. Primer: Per Section 09900 – PAINTING

2.02 FABRICATION

A. Workmanship:

1. General: Shop assemble work in largest practical sections; minimize field connections. Grind smooth parts exposed to view; remove weld marks and leave free of fabrication marks. Miter corners and edges unless otherwise shown. Make members true to length so assembling may be done without fillers. Bends, twists, open joints in finished members, or projecting edges or corners at connections will not be permitted. Miter, cope, and block carefully to produce tight hairline joints. Provide lugs, clips, connections, bolts, and fastenings necessary to complete fabrication.
2. **Galvanizing:** Treat all areas burned off or damaged during fabrication with specified repair compound.

3. **Reinforcement:** Provide proper reinforcement for hardware, and other fabricated metal work, as required.

4. **Welding:** Use sequence welding to minimize distortion and heat stresses. Weld by shielded electric arc process per AWS. Use continuous welding along entire area of contact, except where spot welding is permitted. Grind all welds smooth on exposed surfaces. Spot welding not permitted on exposed surfaces.

5. **Shop Painting:** Per SSPC standards.

**B. Fabrications:**

1. **Bollards:**
   - Steel pipe sections with open ends capped, welded and ground smooth.
   - **Removable Bollards:** Provide galvanized sleeves for setting removable posts. Drill ¼" hole in top cap of removable barriers.

2. **Ladder:**
   - General: Ladder shall meet CAL-OSHA requirements. Fabricate from steel sections per NAAMM Standards; punch side railings to receive steel rungs; space rungs at 12" on center; extend through stringers; weld around each end and grind smooth.
   - Rung shall be coated with non-skid surface.

3. **Safety Post:**
   - LadderUp Safety post, Model No. 1, manufactured by the Bilco Co.
   - Or equal.

4. **Fasteners:** As shown.

**PART III - EXECUTION**

3.01 **PREPARATION**

A. **General:** Refer to Section 01 31 00 – COORDINATION

B. **Conditions of Work in Place:** Carefully examine before beginning work; report defects.

C. **Job Measurements:** Take field measurements; report discrepancies between plan and field dimensions.
3.02 INSTALLATION

A. Performance:

1. General: Install with workmen skilled in the particular type of work required and in accordance with the written instructions of the manufacturers.

2. Coordination: Deliver miscellaneous metal items to be installed in concrete or masonry, complete with all clips, anchors or bolts necessary to secure them in place.

3. Workmanship: Set work plumb and true; properly assemble and erect in a rigid and workmanlike manner. Do cutting, punching, drilling and tapping for attachment of other work coming into contact with fabricated metal work where indicated or as directed. Do necessary cutting, drilling, and fitting for installation of fabricated metal work. Execute drilling, cutting, and fitting carefully; when required, fit work at job before finishing. No burning in field permitted. Replace, or repair parts damaged or injured during erection in an acceptable manner. Drill holes for fasteners to exact diameter as recommended by fastener manufacturer. Oversized holes or holes not properly located that produce misalignment of fastener will be rejected.

4. Field Touch-up: Touch-up damaged surfaces and field welds of steel, scheduled to be painted, per SSPC standards.

5. Protection: After erection, provide proper protection for fabricated metal items from other construction operations.

B. Installation:

1. Bollards:
   a. General: Set in concrete and fill, as shown.
   b. Removable Bollards: Set sleeves with removable cap in concrete as shown; provide smooth insertion and removal of bollard.

2. Ladder:
   a. General: Fasten at top, bottom, and intermediate points not over 6'-0" apart with brackets for fastening; use expansion bolts, unless otherwise shown.
   b. Safety Post: Install at center line of top two rungs on all fixed ladders located below roof hatches. Verify smooth and proper extension to full 42" height.

C. Non-shrink grout:

1. Convene pre-application meeting two (2) weeks before start of application of non-shrink grout.

2. Require attendance of parties directly affecting work of this section, including contractor, architect, engineer, applicator, and manufacturer’s representative.
3. Review materials, surface preparation, forming, mixing, placing, curing, protection, and coordination with other work.

END OF SECTION 05 50 00
SECTION 05 51 00
METAL STAIRS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Steel stair frame of structural sections.
B. Treads, landings and closed risers.
C. Railing assemblies.

1.2 RELATED SECTIONS

A. Section 03 30 00 – Cast-in-Place Concrete.
B. Section 05 12 00 – Structural Steel Framing.
C. Section 05 52 13 – Pipe and Tube Railings.
D. Section 09 91 00 – Painting.

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:

3. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
5. AWS A2.0 – Standard Welding Symbols.
7. SSPC-Paint 20 – Zinc-Rich Coating, Type I-Inorganic and Type II-Organic.
1.4  SUBMITTALS

A. Submit under provisions of Division 01.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, accessories and interfaces with adjacent building elements.
   1. Include erection drawings, elevations and details where applicable.
   2. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld length.
   3. Stair fabricator shall not add any structural elements to the stair that would affect the design of adjacent building elements.

C. Templates: Furnish templates and other devices as necessary for presetting bolts and anchors to accurate conditions.

D. Descriptive Data: Submit complete data for manufactured items.

1.5  QUALITY ASSURANCE

A. Conform to CBC Chapters 17A and 22A.
   1. Materials:
      a. Structural Steel, Cold Formed Steel as per CBC Section 2205A.
      b. Material Identification as per CBC Section 2203A.1.
   2. Inspection and Tests:
      a. Test of High Strength Bolts, Nuts, Washers as per CBC Section 2213A.1.
      b. Welding Inspection as per CBC Section 1705A.2.2.1.
      c. High Strength Bolt Inspection as per CBC Section 1705A.2.1 and Table 1705A.2.1.
      d. Non-Destructive Weld Testing as per CBC Section 1705A.12.2.

1.6  QUALIFICATIONS

A. Fabricator/Installer: For the fabrication and installation of steel stairs, use only personnel who are trained and experienced in the products involved and in the recommended methods for their installation.

B. Welders’ Certificates: Submit under provisions of Division 01, certifying welders employed on the Work, verifying AWS qualification within the previous twelve months.

1.7  FIELD MEASUREMENTS

A. Take field measurements prior to the preparation of shop drawings and fabrication where possible.
1.8 DELIVERY, STORAGE AND HANDLING

A. Coordinate all fabrication and delivery of steel stairs with all related trades to permit stair installation into the structure without delay.

B. Deliver all parts ready for erection; store on clean concrete surface or raised platforms under cover.

PART 2 PRODUCTS

2.1 MATERIALS

A. Metal Surfaces: For fabrication of steel stair work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness. Remove blemishes by grinding and/or welding and grinding prior to cleaning, treating and application of surface finish.

B. Structural Steel Members:

1. ASTM A992 Grade 50 for wide flange and WT shapes.

2. ASTM A36/A36M or ASTM A572 Grade 50 for plates, as noted in Drawings.

3. ASTM A36/A36M for channels, angles and all other shapes.

4. HSS:
   a. Tubing: ASTM A500, Grade B.
   b. Round: ASTM A500, Grade B.

5. Pipe: ASTM A53/A53M, Type E or S, Grade B.

C. Hot-Rolled Carbon Steel Sheets and Strips: ASTM A1011/A1011M.

D. Welding Materials: AWS D1.1, type required for materials being welded.

E. Bolts, Nuts and Washers: Manufacturer's standard.

F. Steel Shop and Touch-Up Primer: Ferrous metal primers as specified in Section 09 91 00 or accepted equal.

G. Handrail brackets at walls shall be steel, as indicated on Drawings.

2.2 FABRICATION

A. Member sizes shall be as shown on Drawings.

B. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

C. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
D. Accurately form components required for anchorage of stairs and landings and railings to each other and to building structure.

E. All stair fasteners shall be provided and installed by stair fabricator.

F. Form work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to radius of approximately 1/32 inch. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

G. Weld corners and seams in accordance with recommendations of AWS. Grind these exposed welds to match and blend with adjoining surfaces.

H. Join rails and corners by mitered and welded joints made by fitting top rail and intermediate rails in a unit and bracketed, or weld to posts as indicated. Butt railing splices and reinforce by a tight fitting interior sleeve. Plumb posts in each direction. Secure posts by welding direct to stair stringers.

I. Remove scale, rust and other deleterious materials before applying shop primer. Apply one shop coat of metal primer to all fabricated metal items.

J. Clean surfaces of rust, scale, grease and foreign matter prior to finishing.

K. Do not prime surfaces in direct contact with concrete or where field welding is required.

L. Prime paint items with one coat of metal primer.

M. Clean and strip primed steel items to bare metal where site welding is required.

N. Fit and shop-assemble in largest practical sections, for delivery to site.

O. Fabricate components with joints tightly fitted and secured.

P. Continuously seal jointed pieces by continuous welds.

Q. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush and hairline. Ease exposed edges to small uniform radius.

2.3 RAILING ASSEMBLIES

A. Refer to Section 05 52 13 – Pipe and Tube Railings.

B. Fabricate from 1-1/2 inch outside diameter, 14 gauge, round, seamless tube, multi-strand with fade away posts; provide matching wall railings.

C. Wall Railings: Install with specified brackets spaced and anchored as indicated. Return handrails to wall. Provide welded steel end caps at returns.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning of installation means erector accepts existing conditions.
C. Verify alignment with adjacent construction. Coordinate related work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.
B. Supply items required to be cast into concrete with setting templates, to appropriate Sections.

3.3 INSTALLATION

A. Erect stairs, landings and railings as shown on approved shop drawings, level and plumb, accurately fitted, free from distortion or defects detrimental to appearance or performance.
B. Provide anchors, plates, angles, hangers and struts required for connecting stairs to structure.
C. Allow for erection loads and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
D. Field-weld components indicated on shop drawings. Perform field welding in accordance with AWS D1.1.
E. Field-bolt and weld to match shop bolting and welding. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
F. Mechanically fasten joints butted tight, flush and hairline. Grind welds smooth and flush.
G. Obtain Architect acceptance prior to site cutting or making adjustments not scheduled.
H. After erection, prime welds, abrasions and surfaces not shop primed, except surfaces to be in contact with concrete and surfaces damaged during construction. Touch-up shall be with same paint as prime coat.
I. Railings:
   1. Refer to Section 05 52 13 – Pipe and Tube Railings.
   2. Standing Railing: Position standing rail on stringers as indicated on Drawings and clamp in desired alignment. Finish weld railing posts and railing ends in place.
   3. Wall Railings: Install with specified brackets spaced and anchored as indicated on Drawings. Return handrails to wall.

3.4 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.
B. Maximum Offset from True Alignment: 1/4 inch.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Aluminum Ships Ladder.

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 ships ladders 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 ships ladders in compliance with industry standards and local codes.

B. Installer Qualifications: Competent and experienced firm capable of selecting fasteners and installing ships ladders 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. Anchorage details to structure shall be subject to OSHPD deferred approval.

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 ships ladder.

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 ladder; and shall not be liable for incidental or consequential damages, losses of or expenses, resulting from the use of ladder 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. Ships Ladder: Model 523 as manufactured by O’Keefe’s, Inc.
   1. Incline: 60 degree, unless otherwise indicated on Drawings.
   2. Finish: Mill finish.

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. Ships Ladder:
   1. Treads shall be not less than 1-1/4 inches high, 4-1/8 inch deep and 2 feet wide; 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.
   2. Ship Ladder Seismic Bottom Support: Manufacturer’s standard; two isolation bearings per stringer.

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 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

A. Install in accordance with manufacturer’s instructions and in proper relationship with adjacent construction.

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
SECTION 05 52 10
PIPE AND TUBE RAILINGS

PART I - GENERAL

1.01 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. Aluminum pipe and tube handrails and railings.
   2. Steel pipe and tube handrails and railings.

1.02 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.

1.03 STORAGE

A. Store handrails and railings in a dry, well-ventilated, weather tight place.
1.04 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.

1.05 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.

1.06 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 II - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements.

1. Aluminum Pipe and Tube Railings:
   a. Alumaguard.
   b. Aluminum Tube Railings, Inc.
   c. Architectural Art Mfg., Inc.
   d. Blum: Julius Blum & Co., Inc.
   e. Braun: J.G. Braun Co.
   f. CraneVeyor Corp.
   g. Hollaender Manufacturing Co.
   h. Moultrie Manufacturing Co.
   i. Newman Bros., Inc.
   j. Sterling Fabricated Systems, Inc.
   k. Superior Aluminum Products, Inc.
   l. Thompson Fabricating Company.
   m. Wagner: R & B Wagner, Inc.
   n. Or equal.
2. Steel Pipe and Tube Railings:
   a. Humane Equipment Co.
   b. Wagner: R & B Wagner, Inc.
   c. Or equal.

2.02 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. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.


C. 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.


D. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.
2.03 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.
   1. For aluminum handrails and railings, use fasteners fabricated from Type 304 or Type 316 stainless steel.

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.

D. Cast-in-Place and Postinstalled Anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
   2. Expansion anchors.

2.04 PAINT

A. Shop Primers: Provide primers to comply with applicable requirements in Division 9 Section "Painting."

2.05 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.
2.06 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 concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.

H. For railing posts set in concrete, provide preset sleeves of steel not less than 6” (150 mm) long with inside dimensions not less than ½” (12 mm) greater than outside dimensions of post, and steel plate forming bottom closure.

I. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

J. Ease exposed edges to a radius of approximately 1/32” (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
K. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.

L. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.

M. Fabricate joints that will be exposed to weather in a watertight manner.

N. Close exposed ends of handrail and railing members with prefabricated end fittings.

O. 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 ¼” (6 mm) or less.

P. 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.

2.07 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.

2.08 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.


C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

1. Color: Match University's Representative's sample.

2. Color: As selected by University's Representative from the full range of industry colors and color densities.

2.09 STEEL FINISHES

A. Galvanized Handrails and Railings: Hot-dip galvanize exterior steel and iron handrails and railings to comply with ASTM A 123. Hot-dip galvanize hardware for exterior steel and iron handrails and railings to comply with ASTM A 153/A 153M.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
1. ASTM A 123, for galvanizing steel and iron products.

2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

C. Fill vent and drain holes that will be exposed in finished work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

D. For galvanized handrails and railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

E. Preparation for Shop Priming: After galvanizing, thoroughly clean handrails and railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.

F. 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 III - EXECUTION

3.01 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.

3.02 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 in-place construction.
3.03 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.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2" (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6" (150 mm) of post.

3.04 ANCHORING POSTS

A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's written instructions:

B. Cover anchorage joint with flange of same metal as post, attached to post as follows:
   1. By set screws.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
   1. For aluminum pipe railings, attach posts as indicated using fittings designed and engineered for this purpose.

D. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.05 ANCHORING RAILING ENDS

A. Anchor railing ends into concrete and masonry with round flanges connected to railing ends and anchored into wall construction with postinstalled anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces.
   1. Connect flanges to railing ends using nonwelded connections.

3.06 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 wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.

4. For steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

5. 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.

3.07 CLEANING

A. Clean aluminum and stainless 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."

D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.08 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.

END OF SECTION 05 52 10
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)


11. E 154-88 Testing Materials for Use as Vapor Barriers Under Concrete Slabs and as Ground Cover in Crawl Spaces.


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 components 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 Method A</td>
<td>ASTM D 3767</td>
<td>1.5 mm (0.060”) 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>34 500 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>
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<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>
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<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)</td>
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<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: Hydrouduct 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>
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<tr>
<td>Polymer</td>
<td>ASTM C 366</td>
<td>High Impact Polystyrene</td>
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<tr>
<td>Thickness</td>
<td>Method B</td>
<td>9.5 mm (0.375&quot;) nominal</td>
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<tr>
<td>Compressive Strength</td>
<td>ASTM D 1621</td>
<td>718 kPa (15,000 lb/ft²)</td>
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<tr>
<td>Flow Rate</td>
<td>ASTM D 4716</td>
<td>0.003 m²/s (15 gal/min./ft)</td>
</tr>
<tr>
<td></td>
<td>(gradient 0.1,37.9 kPa)</td>
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<tr>
<td>GEOTEXTILE</td>
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</tr>
<tr>
<td>Type</td>
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<tr>
<td>Polymer</td>
<td>Polypropylene</td>
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<tr>
<td>Weight</td>
<td>ASTM D 3776</td>
<td>136 g/m² (4.0 oz/yd²)</td>
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<tr>
<td>Tensile Strength</td>
<td>ASTM D 4632</td>
<td>445 N (100 lb)</td>
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<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>
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<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>
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</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, 0.6 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>
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<td>Black with white</td>
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<tr>
<td>Protective coating and white</td>
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<td></td>
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<tr>
<td>Surface treatment.</td>
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<td></td>
</tr>
<tr>
<td>Thickness, Method A nominal</td>
<td>ASTM D 3767</td>
<td>1.42 mm (0.056&quot;)</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), 100 Cycles</td>
</tr>
<tr>
<td>Tensile Strength, Film</td>
<td>ASTM D 412</td>
<td>27 600 kPa (4,000 lb/in.²) minimum</td>
</tr>
<tr>
<td>Puncture Resistance</td>
<td>ASTM E154</td>
<td>800 N (180 lb) 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>
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<tr>
<td>Modified</td>
<td></td>
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<tr>
<td>Lap Adhesion Modified</td>
<td>ASTM D 1876</td>
<td>440 N/m(2.5 lb/in.) minimum</td>
</tr>
<tr>
<td>Resistance to Hydrostatic Head</td>
<td>ASTM D 5385 Modified</td>
<td>70m (231 ft.) minimum</td>
</tr>
<tr>
<td>Permanence Method B</td>
<td>ASTM E 96 modified</td>
<td>0.6 ng/m²sPa (0.01 perms)</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>ASTM D 570</td>
<td>0.5% maximum</td>
</tr>
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</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 Bituthene® 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 filter 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 2 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

1.1 DESCRIPTION:

A. Scope: Work under this Section includes all materials and installation necessary to provide Building Insulation, as shown and detailed on the drawings and specified herein.

B. Related Work Specified Elsewhere:

1. Insulation of pipes and ducts: Division 23 – MECHANICAL.

1.2 REFERENCE STANDARDS

A. 2013 CBC, Section 720.


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.

D. Certificates: Submit manufacturer's certification that insulating materials comply with California Quality Standards for insulating materials; CBC, Section 5311.

1.4 PRODUCT HANDLING

A. General: Refer to Section 01 31 00 – COORDINATION.

1.5 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. Manufacture:

1. Specified products are manufactured by the Owens/Corning Fiberglas Corp., unless otherwise indicated.
2. Manville Building Products or equal.

3. Thickness: As shown; where not shown, as required to meet CBC ratings.

B. Batt Insulation: Faced on one side with foil reinforced kraft (FSK) face; Type III, Class A per ASTM C665; flame spread 25 and smoke developed 50 per ASTM E84.

C. Sound Insulation:
   1. General: Sound Attenuation Batt Insulation; ASTM C665, Type 1, and ASTM E136.

D. Vapor Barrier Membrane: 6 mil plastic sheet; FS L-P-375.

E. Fasteners:
   1. Mechanical:
      a. General: As recommended by manufacturer, for application as shown.
      b. Impaling Spindles: Manufacturer's standard pin spindles, with washers; fastener size as recommended by manufacturer for thickness if insulation.

2. Wire:
   a. General: 16 or 18 gage steel.
   b. Supports:
      1) Manufactured by Tiger Teeth, Inc.
      2) Or equal, no known equal.

3. Adhesive: As recommended by manufacturer.

4. Tape: As recommended by manufacturer, for application shown.

F. Caulking: Per Section 07 92 00 – CAULKING AND SEALANTS.

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.

3.2 INSTALLATION

A. General: Install at exterior walls; ceilings below roof areas, where shown; and other locations, including above suspended ceilings, in strict conformance with referenced standards, the manufacturer's written directions, and as shown. Install wall and ceiling insulation to create complete thermal enclosure around habitable space.
B. Batt Insulation:

1. Ceilings:
   a. General: Install with friction fit at sides and firmly butted ends without gaps or voids.
   b. Joists:
      1) General: Staple to joists at 4” on center; minimize air leaks.
      2) Wire-up Fastening System: Wire and supports as recommended by manufacturer.
   c. Suspended Ceilings: Place in truss spaces above suspended ceiling materials, fit snugly between ceiling supports and at edges and ends to minimize air leaks; extend 12” beyond wall lines.

2. Stud Walls: Install with friction fit at sides and firmly butted ends without gaps or voids; attach faced insulation to studs at 4” on center; minimize air leaks.

C. Sound Insulation: Friction fit to cavity where shown at interior walls.

D. Vapor Barrier Membrane: Attach to exterior framing; lap sheets 4” minimum; seal membrane at door and window openings with caulking as specified under Section 07 92 00 – CAULKING AND SEALANTS.

3.3 CLEANING

A. General: Keep premises free from accumulation of waste and rubbish. At the completion of work remove all surplus materials, rubbish, and debris.

END OF SECTION 07 21 00
SECTION 07 25 00
WEATHER BARRIERS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Weather barrier membrane.
B. Seam tape.
C. Flexible flashings.
D. Fasteners.
E. Accessories.

1.2 RELATED SECTIONS
A. Section 05 40 00 – Cold-Formed Metal Framing.
B. Section 07 60 00 – Flashing and Sheet Metal.
C. Section 08 91 19 – Fixed Louvers.

1.3 REFERENCES
A. The publications listed below form a part of this specification 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. Standards, manuals, and codes refer to the latest edition of such standards, manuals, and codes in effect as of the date of issue of this Project Manual, unless indicated otherwise in CBC Chapter 35 and CFC Chapter 80.

C. Referenced Standards:


11. TAPPI Test Method T-410 – Grams of Paper and Paperboard (Weight per Unit Area).


1.4 SUBMITTALS

A. Submit under provisions of Division 01.

B. Product Data: Submit manufacturer current technical literature for each component specified in this Section.

C. Samples: Two each of weather barrier membrane and flashings, minimum 8-1/2 inches by 11 inch.

D. Quality Assurance Submittals:

1. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with indicated requirements.

2. Manufacturer Instructions: Provide manufacturer’s written installation instructions and details.

3. Manufacturer’s Field Service Reports: Provide site reports from authorized field service representative, indicating observation of weather barrier assembly installation.

E. Closeout Submittals:

1. Submit under provisions of Division 01.

2. Weather Barrier Warranty: Manufacturer’s executed warranty form with authorized signatures and endorsements indicating date of Substantial Completion.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installer shall have experience with installation of specified weather barrier and flexible flashing assemblies under similar conditions.

2. Installation shall be in accordance with weather barrier manufacturer’s installation guidelines and recommendations.

B. Single Source Responsibility: Provide building wrap, flashings, and accessory materials from a single manufacturer to ensure system compatibility and quality, and to comply with manufacturer’s warranty requirements.
C. Pre-installation Meeting:
1. Conduct pre-installation meeting in accordance with provisions of Division 01.
2. Hold a pre-installation conference, two weeks prior to start of weather barrier installation. Attendees shall include Contractor, Architect, installer, Owner’s Representative, and weather barrier manufacturer’s designated representative.
3. Review all related project requirements and submittals, status of substrate work and preparation, areas of potential conflict and interface, availability of weather barrier assembly materials and components, installer’s training requirements, equipment, facilities and scaffolding, and coordinate methods, procedures and sequencing requirements for full and proper installation, integration and protection.

1.6 DELIVERY, STORAGE AND HANDLING
A. Deliver, store, and handle products and materials under provisions of Division 01.
B. Deliver weather barrier materials and components in manufacturer’s original, unopened, undamaged containers with identification labels intact.
C. Store weather barrier materials as recommended by weather barrier manufacturer.

1.7 SCHEDULING
A. Review requirements for sequencing of installation of weather barrier assembly with installation of louvers and flashings to provide a weather-tight barrier assembly.
B. Schedule installation of weather barrier materials and exterior cladding within nine months of weather barrier assembly installation.

1.8 WARRANTY
A. Product and Labor Warranty: Weather barrier manufacturer shall warranty weather barrier assemblies for a period of ten years from date of Project Completion.
   1. Weather barrier manufacturer’s approval for warranty is required prior to assembly installation.

PART 2 - PRODUCTS

2.1 MANUFACTURER
B. Substitutions: Under provisions of Division 01.
2.2 MATERIALS

A. Building Wrap: High-performance, flash spun-bonded olefin, non-woven, non-perforated, secondary weather barrier is based upon DuPont™ Tyvek® CommercialWrap D® and related assembly components or accepted equal.

B. Performance Characteristics:

1. Air Penetration Resistance: <0.04 cfm/ft² at 1.57 psf, when tested in accordance with ASTM E2357. Type 1 per ASTM E1677.

2. Water Vapor Transmission: 30 perms, when tested in accordance with ASTM E96, Method B.

3. Water Penetration Resistance: Minimum 235 cm when tested in accordance with AATCC Test Method 127.

4. Basis Weight: Minimum 2.4 ounces per square yard, when tested in accordance with TAPPI Test Method T-410.

5. Air Penetration Resistance: >750 seconds/100cc, when tested in accordance with TAPPI Test Method T-460.


7. Tear Resistance: 6/9 pounds, when tested in accordance with ASTM D1117.


2.3 FLEXIBLE FLASHINGS

A. DuPont™ FlexWrap™, as manufactured by DuPont™ Building Innovations™.

1. Flexible membrane flashing materials for openings and penetrations.

B. DuPont™ StraightFlash™, as manufactured by DuPont™ Building Innovations™.

1. Straight flashing membrane materials for flashing louver openings and sealing penetrations.

2.4 ACCESSORIES

A. Seam Tape: DuPont™ Tyvek® Tape, three inches wide, as manufactured by DuPont™ Building Innovations™.

B. Fasteners: Tyvek® Wrap Cap Screws, as manufactured by DuPont™ Building Innovations™.

1. 1-5/8 inch rust resistant screw with 2-inch diameter plastic cap fasteners.
C. Sealants:
   1. Provide sealants that comply with ASTM C920, elastomeric polymer sealant to maintain watertight conditions. All sealants shall be California VOC compliant.
   2. Acceptable Products:
      a. Dow Corning® 756.
      b. Tremco 830.
      c. Tremco Butyl.
      d. Other sealants recommended by the weather barrier manufacturer.

D. Adhesives:
   1. Provide adhesive recommended by weather barrier manufacturer. All adhesives shall be California VOC compliant.
   2. Acceptable Products:
      a. SIA 655.
      b. Other adhesives recommend by the weather barrier manufacturer.

E. Primers:
   1. Provide flashing manufacturer recommended primer to assist in adhesion between substrate and flashing. All primers shall be California VOC compliant.
   2. Acceptable Products:
      a. SIA 655.
      b. Other primers recommended by the flashing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

3.2 INSTALLATION - WEATHER BARRIER
   A. Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations
   B. Install weather barrier prior to installation of louvers, and exterior cladding materials.
   C. Start weather barrier installation at a building corner, leaving 6 inches to 12 inches of weather barrier extended beyond corner to over lap.
D. Install weather barrier in a horizontal manner starting at the lower portion of the wall surface with subsequent layers installed in a shingling manner to overlap lower layers. Maintain weather barrier plumb and level.

E. Sill Plate Interface: Extend lower edge of weather barrier over sill plate interface 6 inches. Secure to foundation with elastomeric sealant as recommended by weather barrier manufacturer.

F. Louver Openings: Extend weather barrier completely over openings.

G. Overlap weather barrier:
   1. Exterior Corners: Minimum 12 inches.
   2. Seams: Minimum 6 inches.

H. Weather Barrier Attachment:
   1. Attach weather barrier to steel studs through exterior sheathing. Secure using weather barrier manufacturer recommend fasteners, space 6 inches to 18 inches vertically on center along stud line, and 24 inches on center, maximum horizontally.

I. Apply 4 inch by 7 inch piece of DuPont™ StraightFlash™ to weather barrier membrane prior to the installation cladding anchors.

3.3 SEAMING

A. Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams.

B. Seal any tears or cuts as recommended by weather barrier manufacturer.

3.4 OPENING PREPARATION

A. Flush cut weather barrier at edge of sheathing around full perimeter of opening.

B. Cut a head flap at 45-degree angle in the weather barrier at opening head to expose 8 inches of sheathing. Temporarily secure weather barrier flap away from sheathing with tape.

3.5 FLEXIBLE FLASHINGS

A. Cut wide DuPont™ FlexWrap™ a minimum of 4 inches wider than stud depth and 12 inches longer than length of sill rough opening.

B. Cover horizontal sill by aligning DuPont™ FlexWrap™ edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.

C. Fan DuPont™ FlexWrap™ at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.
D. Apply 9 inch wide strips of DuPont™ StraightFlash™ at jambs. Align flashing with interior edge of jamb framing. Start StraightFlash™ at head of opening and lap sill flashing down to the sill.

E. Spray-apply primer to top 6 inches of jambs and exposed sheathing.

F. Install DuPont™ FlexWrap™ at opening head using same installation procedures used at sill. Overlap jamb flashing a minimum of 2 inches.

G. Coordinate flashing with louver installation.

H. On exterior, install backer-rod in joint between louver frames and flashed rough framing. Apply sealant at jambs and head, leaving sill unsealed. Apply sealants in accordance with sealant manufacturer's instructions and ASTM C1193.

I. Position weather barrier head flap across head flashing. Adhere using 4 inch wide DuPont™ StraightFlash™ over the 45-degree seams.

J. Tape top of opening in accordance with manufacturer recommendations.

K. On interior, install backer rod in joint between frame of louver and flashed rough framing. Apply sealant around entire opening to create air seal. Apply sealant in accordance with sealant manufacturer's instructions and ASTM C1193.

3.6 FIELD QUALITY CONTROL

A. Notify manufacturer's designated representative to obtain required periodic observations of weather barrier assembly installation.

3.7 PROTECTION

A. Protect installed weather barrier from damage.

END OF SECTION 07 25 00
SECTION 07 26 50
VAPOR CONTROL MEMBRANE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: The Work of this Section includes all material and installation of Vapor Barriers for concrete slabs prior to installation of Resilient Tile Flooring, Sheet Vinyl Floor Coverings, Resilient Flooring Accessories, and Carpet as shown and detailed on the Drawings and specified herein.

B. Related Sections:
   1. Section 03 30 00 – Cast-in-Place Concrete.
   2. Section 09 65 19 – Resilient Tile Flooring

1.2 SUBMITTALS

A. General: See Section 01 33 23 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Product Data: For each type of product specified.

C. Two Samples of the finished membrane must be submitted to University’s Representative prior to beginning application.

   1. Shop Drawings: Show locations and details of waterproofing preparation and application. Show expansion joint details and waterproofing application at obstructions and penetrations.

1.3 QUALITY ASSURANCE

A. Applicator Qualifications: An experienced applicator who has completed modified cement waterproofing similar in material, design, and extent to that indicated for this Project and whose work has resulted in application with a record of successful in-service performance.

B. The finished system shall demonstrate a reduction of moisture vapor emission to a level satisfactory to the manufacturer of the finished flooring materials.

C. The manufacturer of each product shall supply a written warranty, See 1.5 "Warranty".

D. EPA-Environmental Protection Agency: All components must be V.O.C. compliant to current requirements.

1.4 PROJECT CONDITIONS

A. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after concrete and masonry substrate defects, including honeycombs,
voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

1. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40°F (4°C) or above during work and cure period and space is well ventilated and kept free of water.

1.5 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1. Special Warranty: Written warranty, signed by Applicator and countersigned by Contractor agreeing to repair or replace waterproofing that does not comply with requirements or that fails to perform as required, and to maintain watertight conditions within specified warranty period. Warranty includes responsibility for removing and replacing other work that conceals modified cement waterproofing. During warranty period, repairs and replacements required because of unusual weather phenomena and other events beyond Contractor's or Applicator's control shall be completed by Contractor or Applicator and paid for by Owner at prevailing rates.

a. Warranty Period: As mandated by each manufacturer from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to flooring manufacturers requirements, based on the products specified.

2.2 MATERIALS

A. Vapor Control Membrane: A topical water-based vapor emission membrane system as recommended by the flooring manufacturer.

1. Water Vapor Transmission (Water Method), ASTM E96: Performance of the System shall be documented by an independent testing laboratory. Test net perm rate results shall not exceed 0.11 grains h-1 ft-2 in Hg-1.

2. System shall meet or exceed all aspects of the standards set forth in ASTM F3010.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and other surfaces where waterproofing is to be applied with Applicator present, for compliance with requirements for surface preparation, cleaning, and other conditions affecting waterproofing performance.

B. Proceed with application only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Protect other work from fallout or overspray from modified cement waterproofing during application. Provide temporary enclosure to confine spraying operation, to prevent polluting the air, and to ensure adequate ambient temperatures and ventilation conditions for application.

B. Grind down high spots and protrusions; clean concrete of debris and dust; fill cracks, cavities, and low spots with a cement-based compound. Gypsum-based underlayment and filler materials not permitted.

C. Schedule cleaning and surface preparation so dust and other contaminants from the cleaning and preparation process will not fall on wet, newly coated surfaces.

D. Surface Preparation of Concrete: Comply with waterproofing manufacturer's written instructions and requirements indicated below to ensure that waterproofing bonds to concrete surfaces. Clean concrete surfaces according to ASTM D 4258 by using one or a combination of procedures as needed to effectively remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, curing compounds, and form-release agents.

E. If the pH level of the subfloor is above 9, refer to written instructions per the manufacturer's instructions.

F. Prepare floors for sealant as recommended by flooring manufacturer.

G. Concrete Joints: Clean reveals according to waterproofing manufacturer's written instructions.

H. Pre-Sealer: Provide in areas where calcium chloride moisture tests indicate vapor emissions greater than nine (9) pounds or as recommended by manufacturer per 1,000 square feet per 24 hours.

3.3 APPLICATION

A. General: Comply with waterproofing manufacturer's written instructions, unless more stringent requirements are indicated.

B. Mix waterproofing components according to waterproofing manufacturer's written instructions.

C. Apply waterproofing coating evenly and fill voids and pores of substrate with waterproofing slurry. Keep tools clean and free from build-up.

D. Apply the number of coats at the rates recommended by the manufacturer for each coat. After allowing previous coat to cure, dampen the slab before applying additional coats.

1. Mist-cure waterproofing for two to three days immediately after application as recommended by the manufacturer.
2. Wet-cure waterproofing when temperatures are above 85°F (29°C), relative humidity is below 30%, wind speed exceeds 15 mph (24 km/h), or waterproofing is exposed to direct sunlight for 72 hours after placement.

3.4 PROTECTION

A. Protect applied modified cement waterproofing from rapid drying, severe weather exposure, and water accumulation. Maintain completed Work in moist condition for not less than seven days by covering with impervious sheeting or by other curing procedures recommended by waterproofing manufacturer.

END OF SECTION 07 26 50
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Materials and installation methods for fluid-applied, vapor permeable air barrier membrane system and flexible flashings located in the non-accessible part of the wall.

B. Materials and installation methods to bridge and seal air leakage pathways in roof and foundation junctions, window and door openings, control and expansion joints, piping and other penetrations through the wall assembly.

1.2 RELATED SECTIONS

A. Section 07 42 43.16 – Aluminum Composite Wall Panels.

B. Section 07 62 00 – Sheet Metal Flashing and Trim.

C. Section 07 92 00 – Joint Sealants.

D. Section 09 29 00 – Gypsum Board: Mat-Faced Gypsum Sheathing.

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:


11. ASTM D4258 – Practice for Surface Cleaning Concrete for Coating.


14. ASTM E154 – Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

15. ASTM E1186 – Practice for Air Leakage Site Detection in Building Envelopes and Air Retarder Systems.


1.4 SUBMITTALS

A. Product Data: Include manufacturer’s written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashings, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1. Include details of interfaces with other materials that form part of air barrier.

2. Include details of mockups.

C. Samples: Submit representative samples of the following for review:

1. Fluid-applied membrane.

2. Flexible flashings.
D. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.

E. Qualification Data: For Applicator.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers, submit certified test report showing compliance with requirements specified for ASTM E2178.

G. Warranty: Submit a sample warranty identifying the terms and conditions stated in Article 1.10.

1.5 DEFINITIONS

A. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.6 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. The air barrier shall have the following characteristics:

1. It must be continuous, with all joints made airtight.

2. It shall have an air permeability not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 inches water (1.57 psf), when tested in accordance with ASTM E2178.

3. It shall have an air permeability not to exceed 0.04 cubic feet per minute per square foot under a pressure differential of 0.3 inches water (1.57 psf), when tested in accordance with ASTM E2357.

4. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.

5. It shall be durable and maintainable.
6. The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:

   a. Foundation and walls.
   b. Walls and windows or doors.
   c. Different wall systems.
   d. Wall and roof.
   e. Wall and roof over unconditioned space.
   f. Walls, floor and roof across construction, control and expansion joints.
   g. Walls, floors and roof to utility, pipe and duct penetrations.

7. All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made airtight.

1.7 QUALITY ASSURANCE

A. Manufacturer: Air barrier systems shall be manufactured and marketed by a firm with a minimum of twenty years experience in the production and sales of waterproofing and air barriers. 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 five years.

B. Source Limitations: Obtain primary air-barrier material and flexible flashings through one source from a single manufacturer.

C. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

D. Mockups: Before beginning installation of air barrier, provide air barrier work for exterior wall assembly mockups, incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.

1. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed.

2. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are acceptable.
E. 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. Preinstallation conference shall include the Contractor, installer, Architect, and system manufacturer's field representative. Agenda for meeting shall include, but not be limited to, the following:

1. Review of submittals.
2. Review of surface preparation, minimum curing period and installation procedures.
3. Review of special details and flashings.
4. Sequence of construction, responsibilities and schedule for subsequent operations.
5. Review of mock-up requirements.
6. Review of inspection, testing, protection and repair procedures.

1.8 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.

B. Do not double-stack pallets of fluid applied membrane components on the job site. Provide cover on top and all sides, allowing for adequate ventilation.

C. Protect fluid-applied membrane components from freezing and extreme heat.

D. Sequence deliveries to avoid delays, but minimize on-site storage.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a wet substrate or during snow, rain, fog, or mist.

1.10 WARRANTY

A. Submit manufacturer's warranty that air barrier, flexible flashings, and accessories are free of defects at time of delivery and are manufactured to meet manufacturer's published physical properties and material specifications.

B. Warranty Period: Five years from date of Project Completion.

C. Installer to warrant that air barrier, flexible flashings, and accessories have been installed in accordance with manufacturer's recommendations.
PART 2 PRODUCTS

2.1 MANUFACTURERS

   1. Air Barrier: Perm-A-Barrier® VPO.
   2. Flexible Flashings: Vycor Pro Flashing.
   4. Primers:
   5. Liquid Membrane for Details and Terminations: Bituthene Liquid Membrane.
   7. Joint Sealant: S100 Sealant, one part neutral curing, ultra low modulus silicone sealant.

   1. Air Barrier: ExoAir 230.
   2. Flexible Flashings: ExoAir 110.
   3. Liquid Membrane for Details and Terminations: ExoAir Termination Mastic.

   1. Air Barrier: Air-Bloc 33
   2. Flexible Flashings: Blueskin SA.

D. Substitutions: Under provisions of Division 01.
2.2 MATERIALS

A. Fluid-Applied Air Barrier Membrane: Fluid-applied, vapor permeable, acrylic membrane that provides continuous air tightness and water protection throughout the wall assembly. The membrane shall be dark-colored and designed for exposure to indirect and intermittent sunlight, such as behind open joint rain screen systems. Product shall have the following minimum physical properties:

1. Membrane Air Permeance: ASTM E2178, not to exceed 0.0004 cubic feet per minute per square foot under a pressure differential of 0.3 inches water (1.57 psf).

2. Assembly Performance: Provide a continuous air barrier assembly that has an air leakage not to exceed 0.0008 cubic feet per minute per square foot of surface area under a pressure differential of 0.3 inches water (1.57 psf) when tested in accordance with ASTM E2357.


4. Peel Adhesion: ASTM D903, minimum 5 pounds per inch or substrate failure to glass faced wall board.

5. Pull Adhesion: ASTM D4541, minimum 50 psi or substrate failure to glass faced wall board.

6. Weather Resistance: Maintain physical properties after 84 daily cycles of UV.


8. Low Temperature Flexibility and Crack Bridging: ASTM C836, pass at -15 degrees F.


B. Flexible Flashings: 11 mils of a clear or translucent colored controlled flow butyl adhesive integrally bonded to 3 mils of engineered polypropylene film to provide a minimum 14 mil thick membrane. Membrane shall be interleaved with silicone-coated polyester release film until installed, conforming with the following:

1. Meets or exceeds the requirements set forth in AAMA 711-05 voluntary specification for self adhered flashing Level 3 requirement for elevated temperature exposure.

2. Meets or exceeds the requirements set forth in ASTM E2112 for flashing exterior windows and doors.

3. Water Penetration Around Nails: ASTM D1970 Section 7.9, modified per section 5.2.1 of AAMA 711 voluntary specification – Pass 1.2 in head of water.


5. Thickness: ASTM 3652, Minimum 14 mils.

6. Color: Clear or translucent upon visual inspection.
C. Flexible Membrane Aluminum Flashing: 35 mils of self-adhesive rubberized asphalt integrally bonded to 5 mil of aluminum film to provide a minimum 40 mil thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed, conforming with the following:

1. Water Absorption: ASTM D570, maximum 0.1 percent by weight.
4. Low Temperature Flexibility: ASTM D1970 Modified, unaffected to -15 degrees F.

2.3 PRIMERS

A. Wall Primer for Self-Adhered Transition Membrane and Self-Adhered Flexible Membrane Wall Flashing: Water-based primer which imparts an aggressive, high tack finish on the treated substrate.

1. Flash Point: No flash to boiling point.
2. VOC Content: Not to exceed 10 grams per liter.
3. Application Temperature: 25 degrees F and above.
4. Freezing point (as packaged): 21 degrees F.

2.4 PENETRATIONS AND TERMINATION SEALANT

A. Liquid Membrane for Details and Terminations: Two-part, elastomeric, trowel grade material designed for use with fluid-applied membranes, self-adhered membranes and tapes. Ten grams per liter maximum VOC content.

B. Substrate Patching Membrane: Two-part, elastomeric, trowel grade material designed for use with fluid-applied membranes, self-adhered membranes and tapes. Ten grams per liter maximum VOC content.

C. Joint Sealant: Silicone type, refer to Section 07 92 00.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrates and conditions are ready to accept the Work of this Section. Notify Architect in writing of any discrepancies. Commencement of the Work or any parts thereof shall mean acceptance of the prepared substrates.
B. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants detrimental to the adhesion of the membranes. Fill voids, gaps and spalled areas in substrate to provide an even plane. Strike masonry joints full-flush.

C. Curing compounds or release agents used in concrete construction must be resin based without oil, wax, or pigments.

3.2 SURFACE PREPARATION

A. Refer to manufacturer’s literature for requirements for preparation of substrates. Surfaces shall be 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 that are acceptable to manufacturer of the fluid-applied air barrier assembly.

B. Exterior Sheathing Panels: Ensure that the boards are sufficiently stabilized with corners and edges fastened with appropriate screws. Pre-treat all board joints with 2 inch to 3 inch wide, manufacturer’s recommended mesh-style wallboard tape. Gaps greater than 1/4 inch should be filled with mastic or caulk, allowing sufficient time to fully cure before application of the mesh-style wallboard tape and fluid applied air barrier system.

C. Related Materials: Treat construction joints and install flashing as recommended by manufacturer.

D. Clean, prepare, treat, and seal substrate according to manufacturer’s written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

E. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

F. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

G. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.

H. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

I. At changes in substrate plane, apply sealant or liquid membrane at sharp corners and edges to form a smooth transition from one plane to another.

J. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

A. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C1193 and with air barrier manufacturer’s written instructions. Apply mesh-style wallboard tape to all sheathing joints prior to applying fluid air barrier membrane.
3.4 AIR BARRIER MEMBRANE INSTALLATION

A. Apply air barrier membrane to achieve a continuous air barrier according to air barrier manufacturer's written instructions.

B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.

C. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.

1. Vapor-Permeable Membrane Air Barrier: 90 mil wet film thickness; 45 mil dry film thickness.

D. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.5 FLEXIBLE FLASHING INSTALLATION

A. General: Install flashing to dry surfaces at air and surface temperatures of five degrees F and above in accordance with manufacturer's recommendations at locations indicated on Drawings.

B. Flexible Flashings:

1. Precut pieces of flashing to easily handled lengths for each location.

2. Remove silicone-coated release paper and position flashing carefully before placing it against the surface.

3. When properly positioned, place against surface by pressing firmly into place by hand roller. Fully adhere flashing to substrate to prevent water from migrating under flashing.

4. Overlap adjacent pieces 2 inches and roll all seams with a steel hand roller.

5. Trim bottom edge 1/2 inch back from exposed face of the wall. Flashing shall not be permanently exposed to sunlight.

6. At heads, sills and all flashing terminations turn up ends a minimum of 2 inches and make careful folds to form an end dam, with the seams sealed.

7. Do not expose flashing membrane to sunlight for more than one hundred and twenty days prior to enclosure.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections and prepare test reports.
B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition membrane have complied with minimum requirements and have been shingled in the correct direction, or mastic has been applied on exposed edges, with no fish-mouths.
8. Termination sealant has been applied on cut edges.
9. Strips and transition membrane have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Tests: Testing to be performed will be determined by Owner's testing agency from among the following tests:

1. Qualitative Testing: Air barrier assemblies shall be tested for evidence of air leakage according to ASTM E1186.

D. Remove and replace deficient air barrier components and retest as specified above.

3.7 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

B. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace main air barrier material exposed for more than 180 days.
C. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

D. Remove masking materials after installation.

END OF SECTION
SECTION 07 42 43.16
ALUMINUM COMPOSITE WALL PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Aluminum composite panel system.

1.2 RELATED SECTIONS

A. Section 01315 – Additional Requirements for OSHPD Reviewed Projects: Deferred Approvals.

B. Section 05 12 00 – Structural Steel Framing.

C. Section 05 40 00 – Cold-Formed Metal Framing.

D. Section 07 27 26 – Fluid-Applied Membrane Air Barriers.

E. Section 07 62 00 – Sheet Metal Flashing and Trim.

F. Section 07 92 00 – Joint Sealants.

G. Section 09 29 00 – Gypsum Board: Mat-faced gypsum sheathing.

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:


6. ASTM E84 – Standard Test Method for Surface Burning Characteristics of
Building Materials.


1.4 SUBMITTALS

A. General: Submit in accordance with Division 01.

B. Product Data: Submit manufacturer’s descriptive literature and product specification for each product. Include installation instructions.

C. Shop Drawings:

1. Indicate panel layout including dimensions.

2. Show anchorage details, integration with adjacent surfaces and materials.

3. Submit drawings showing field measured dimensions.

D. Design Calculations:

1. Submit design calculations prepared, signed, and stamped by a Structural Engineer licensed in the State of California.

E. Samples:

1. Submit two 6 inch by 6 inch panel samples for each color.

2. Submit one sample of each anchoring assembly and accessories.

F. Closeout Submittals: Operation and maintenance data.

1.5 PERFORMANCE REQUIREMENTS

A. Provide composite metal panels which have been manufactured, fabricated, and installed to withstand loads from deflection and thermal movement and to maintain performance criteria in accordance with CBC and as specified in this Section. Refer to Structural Drawings for structural design criteria.

B. Secondary supports for the wall panel system shall be designed in accordance with AISC or AA design procedures. Through-tube support systems shall be designed and installed only by the manufacturer and certified wall systems contractor.

1. Secondary supports shall not vary from the theoretical plane by more than the specified tolerances.

   a. 1/4 inch in any 20-foot length vertically or horizontally.

   b. 1/2 inch in any building elevation.
c. 1/8 inch within five feet of any change in plane such as corners or soffits.

C. The wall panel system and secondary supports shall be designed to allow differential movement of the building's roof and floor structures.

D. Wall panel system shall be based on design temperature of 70 degrees F. The wall panel system shall accommodate expansion and contraction movement due to surface temperature differentials of 180 degrees F without causing buckling, stress on panels, failure of joint seals, excessive stress on structural elements, reduction of performance, and other detrimental effects.

E. Performance of the wall panel system shall be verifiable with tests witnessed or conducted by independent third-party agencies acceptable to Architect.

   1. Structural performance of the wall panels shall be derived from ASTM E72 Chamber Method with a deflection limit of 1/175 applied to positive load. Ultimate structural values shall be achieved without the use of backside mechanical attachments to the structure.

   2. There shall be no evidence of delamination of the wall panels after two million cycles of positive and negative L/175 deflection.

   3. Thermal performance of the wall panels shall be based on tests in accordance with ASTM C1363 corrected to 15 mph outside and still air inside. Tests shall include side-joint, standard fastening and integral reveals or profiling.

   4. Air infiltration of the wall panels shall not exceed 0.06 cfm/sf per square feet at a static pressure of 1.57 psf when testing in accordance with ASTM E283.

   5. There shall be no uncontrolled water penetration under static pressure when tested in accordance with ASTM E331 at a differential of 18 percent inward acting design load, 6.24 psf minimum after 15 minutes.

      a. Water penetration is defined as the appearance of uncontrolled water in the wall.

      b. Wall design shall feature provisions to drain the exterior face of the wall any leakage of water at joints and any condensation that may occur within the construction.

1.6 QUALITY ASSURANCE

A. Qualifications:

   1. Manufacturer/Fabricator Qualifications: Firm specializing in manufacturing products specified in this Section with a minimum five years experience.

   2. Installer Qualifications: Firm specializing in installing work specified in this Section acceptable to manufacturer with experience on at least five projects of similar nature in past three years.

B. Single Source Responsibility: Obtain composite panel system including component panels and anchorage system from a single manufacturer.
C. Pre-Installation Meetings
   1. Conduct pre-installation meeting in accordance with Division 01. Verify substrate conditions, installation instructions, and warranty requirements.
   2. Convene pre-installation meeting one week prior to commencing work of this Section.
   3. Coordinate work in this Section with work in related Sections.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Comply with requirements of Division 01.
B. Deliver products in manufacturer's original containers, dry and undamaged, with seals and labels intact.
C. Package composite metal wall panels for protection against transportation damage. Provide markings to identify components consistent with drawings.
D. Exercise care in handling, storing, and installing panels to prevent bending, warping, twisting, and surface damage.
E. Storage and Protection
   1. Store materials in a dry secure place, well ventilated, and out of direct sunlight. Protect from weather, surface contaminants, corrosion, construction traffic, and other potential damage.
   2. Slope panels to ensure positive drainage of any accumulation of water.
   3. Do not store panels in any enclosed space where ambient temperature can exceed 120 degrees F.
   4. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

1.8 MAINTENANCE
A. Operations and Maintenance Data:
   1. Submit in accordance with Division 01.
   2. Furnish cleaning and maintenance information.

PART 2 - PRODUCTS
2.1 PRODUCTS AND MANUFACTURERS
A. Acceptable Products and Manufacturers:
   1. Alucobond by 3A Composites USA Inc., Benton, KY; 800-626-3365
2.2 COMPOSITE METAL PANELS

A. Materials:

1. Two sheets of aluminum face sheets sandwiching a solid core of thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials.

2. Face Sheets: Aluminum 3105-H14 alloy; minimum 0.0197 inch thick.

3. Core: Thermoplastic material, free of voids or air spaces and shall not contain foamed insulation material.

B. Properties:

1. System:
   a. Rout and return dry seal; reveal joint as shown on drawings, sealant as specified in Section 07 92 00 and with foam type backer rod.
   b. System shall not have any visible fasteners, telegraphing or fastening on the panel faces or any other compromise of a neat and flat appearance.
   c. System shall be designed so that no restraints can be placed on the panel which might result in compressive skin stresses. The installation detailing shall be such that the panels remain flat regardless of temperature change and at all times remain air and water tight in accordance with performance requirements as specified in this Section.
   d. Outside corners shall be back-routed and shop bent.

2. Panel thickness and weight: 0.157 inch (4 mm), 1.12 pounds per square foot.

   a. Flame spread: 120 per ASTM E84.
   b. Smoke developed: 450 maximum per ASTM E84.

4. Bond Integrity:
   a. Bond strength: 1,500 psi minimum per ASTM C297.
b. Peel strength: 33.6 in-lb/in minimum per ASTM D1781.

c. No change in bond performance after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.

2.3 ACCESSORIES

A. Provide manufacturer’s standard accessories including fasteners, clips, anchorage devices and attachments.

B. Sealant: Refer to Section 07 92 00.

2.4 FABRICATION

A. Fabricate panels to sizes and joint configurations indicated on approved shop drawings. Where final dimensions cannot be established by field measurements, provide allowance for field adjustment as recommended by manufacturer.

B. Form panel lines, breaks, and angles sharp and true, with surfaces free from warp or buckle.

C. Fabricate with sharp edges, with no displacement of aluminum sheet or protrusion of core.

D. Fabricate panels with removable protective film.

E. Fabrication Tolerances:

1. Width: Plus 0.08 inch.

2. Length: Plus 0.22 inch.

3. Thickness: Plus 0.008 inch.

4. Bow: Maximum 0.5 percent of length or width.

5. Squareness: 0.2 inch.

6. Edges of sheets shall be square and trimmed with no displacement of aluminum sheets or protrusion of core material.

2.5 FINISH

A. Finish: Coil-coated; 70 percent Polyvinylidene Fluoride (PVDF) in accordance with AAMA 2605; color as selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine job site conditions and verify field dimensions. Verify substrate is plumb, level, and parallel.

B. Report unacceptable conditions to Architect. Begin installation only when unacceptable conditions have been corrected.

3.2 INSTALLATION

A. Protection: Protect adjacent work and finish surface from damage during installation.

B. Install in accordance with manufacturer’s printed instructions and approved shop drawings.

C. Install units plumb, level, and square, and free from warp or twist while maintaining dimensional tolerances and alignment with adjacent surfaces.

D. Anchor panels securely in place. Comply with manufacturer’s instructions for concealed fasteners.

E. Do not cut, trim, weld or braze component parts during erection in a manner which would damage the finish, decrease strength, or result in visual imperfection or failure in performance. Return component parts which require alteration to shop for re-fabrication, replace with new parts if re-fabrication will result in unacceptable conditions as specified in this Section.

F. Separate dissimilar metals and use gasketed fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.

G. Repair panels with minor damage so that repairs are not discernible at a distance of ten feet.

H. Remove and replace panels damaged beyond repair.

I. Remove protective film immediately after installation of Joint Sealants and immediately prior to completion of composite metal panel work.

J. Remove from project site damaged panels, protective film, and other debris attributable to work of this Section.

3.3 FIELD QUALITY CONTROL

A. General: Comply with requirements of Division 01.

B. Installation Tolerances: Maximum deviation from horizontal and vertical alignment of installed panels: 0.25 inch in 20 feet, non-cumulative.

C. Manufacturer’s Field Services: Provide manufacturer’s field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer’s instructions.

3.4 CLEANING

A. Clean as recommended by manufacturer. Do not use materials or methods which may damage finish surface or surrounding construction.
B. Protect installed product’s finish surfaces from damage during construction. Provide protective covering as required to ensure installed panels will not be damaged by work of other trades.

END OF SECTION 07 42 43.16
SECTION 07 50 00
SINGLE PLY ROOFING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work of this Section shall include all materials and installation necessary to provide Single-Ply Roofing as shown and detailed on the Drawings and specified herein, including:

1. PVC single-ply membrane over new poly-iso board insulation over new concrete deck.

B. Related Work: The work includes but is not necessarily limited to the installation of:

1. Fasteners
2. Roof Membrane
3. Roof Membrane Flashings
4. Walkways
5. Metal Flashings
6. Sealants and Adhesives
7. Insulation (at new crickets and at specified roof areas)

1.2 QUALITY ASSURANCE

A. This roofing system shall be applied only by a Contractor authorized by the respective PVC single-ply manufacturer prior to bid.

B. Contractor shall provide as follows: Upon completion of the installation, and the delivery to the PVC single-ply manufacturer by the Contractor of a certification that all work has been done in strict accordance with the contract specifications and manufacturers' requirements, an inspection shall be made by a representative of the manufacturer to observe the roofing system.

C. All work shall be completed by personnel trained and authorized by the PVC single-ply manufacturer.

D. All work must be inspected by UCD Fire Department.

1.3 CODE REQUIREMENTS

A. The roofing Contractor shall submit evidence that the proposed roofing system will meet the identified requirements of the following recognized code approval or testing agencies. These requirements are minimum standards and no roofing work shall commence without written documentation of the system's compliance, as required in the "Submittals" section of this specification.
1. Factory Mutual Research Laboratories, Norwood, Massachusetts.
   a. F. M. Class I system acceptance.
   b. F. M. I-90 wind uplift resistance.

2. Underwriters Laboratories, Chicago, IL.
   a. U. L. Class A membrane.

3. All work to comply with Title 24.

1.4 SUBMITTALS

A. After the notice to proceed the roofing Contractor shall submit to the University's Representative the following:


2. Samples of each material to be used in the roof system including each component of manufacturer's literature.

3. Specimen copy of warranty – material and labor and Contractor's warranty per Division 1.

4. Dimensional shop drawings which shall include:
   a. Outline of roof and roof size.
   b. Profile details of flashing methods for penetrations and terminations.
   c. Technical acceptance from PVC manufacturer.

5. Written approval from the PVC manufacturer for this application on system specified.

6. Letter from PVC manufacturer stating Contractor is an approved applicator.

7. MSDS sheets for all adhesives are to be submitted to UCD Fire Department for review.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All products delivered to the job site shall be in the original unopened containers or wrapping

B. Handle all materials to prevent damage. Place all materials on pallets and fully protected from moisture.

C. Membrane roofs shall be stored lying down on pallets, and fully protected from moisture with clean canvas tarpaulins.

D. Bonding adhesives shall be stored at temperatures above 40°F.
E. All flammable materials shall be stored in a cool, dry area away from sparks and open flames. Follow precautions outlined on container or supplied by material manufacturer/supplier. The proposed storage site for flammable solvents must be off-site or a minimum of 20’ from the Hospital. The site must be approved by UCD Fire Department prior to delivery.

F. All materials which are determined damaged by the University's Representative are to be removed from the job site and replaced at no cost to the University.

1.6 PROJECT CONDITIONS

A. PVC single-ply materials may be installed under the following weather conditions (extreme temperatures, moisture, humidity), but only after consultation with PVC manufacturer and University's Representative, as performance of PVC single-ply materials, as well as installation costs and production may be affected.

B. Only as much of the new roofing as can be made weather tight each day, including all flashings, and metal work shall be installed.

C. All work shall be scheduled and executed without exposing the interior building areas to the effects of inclement weather. The existing building and its contents shall be protected against all risks.

D. All surfaces to receive new insulation, membrane or flashings shall be thoroughly dry. Should surface moisture occur, the Contractor shall provide the necessary equipment to dry the surface prior to application.

E. All new temporary construction, including equipment and accessories, shall be secured in such a manner, at all times, as to preclude wind blow-off or damage.

F. Temporary waterstops shall be installed at the end of each day's work, and shall be removed before proceeding with day's work. Waterstops shall be compatible with all materials and shall not emit dangerous or incompatible fumes.

G. The Contractor is cautioned that certain PVC single-ply membranes are incompatible with asphalt, coal tar and oil based materials and cements. Creosote and penta-based materials are also incompatible. Such materials should not come in contact with PVC membranes at any time. If such contacts occur, the material shall be cut out and discarded. The Contractor should consult PVC manufacturer with respect to material compatibility, precautions, and recommendations.

H. Arrange work sequence to avoid use of newly-constructed roofing for storage, walking surface, and equipment movement. Where such access is absolutely required, the Contractor shall provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas. Both plywood and polyester felt protection shall be provided for all new and existing roof areas which receive traffic during construction.

I. Prior to and during application, all dirt, debris and dust shall be removed from surfaces either by vacuuming, sweeping, blowing with compressed air and/or similar methods.

J. All roofing, insulation, flashings and metal work removed for construction shall be immediately taken off the site to a legal dumping area authorized to receive such materials.
K. The Contractor shall follow all safety regulations as recommended by OSHA.

L. The Contractor should take care during application and storage that overloading of deck and structure does not occur.

M. Liquid materials such as solvents and adhesives shall be stored and used away from open flames, sparks and excessive heat.

N. Contaminants, such as grease, fats, oils, and solvents, shall not be allowed to come into contact with the PVC single-ply roofing membrane except as noted and at specified area and only as delineated within the contract documents. Any other such contact shall be reported to the University's Representative.

O. Contractor shall verify that all roof drain lines are unblocked before starting work. Report any such blockages to the University's Representative in writing.

P. If any unusual or concealed condition is discovered, stop work and notify University's Representative immediately in writing.

Q. Site clean-up, including both interior and exterior building areas which have been affected by construction, shall be completed to the University's satisfaction.

R. All landscaped areas affected by construction activities shall be returned to their pre-construction state.

S. The degree to which the roof deck allows air infiltration into the roof assembly may add to the uplift forces on the roof system:
   1. If any wall openings greater than 10% of the wall surface, contact PVC manufacturer for recommendations.
   2. The effects of positive pressure inside the building must be considered. For conditions of positive pressure greater than 0.5” of water inside the building, contact PVC manufacturer for recommendations.

T. No work is to proceed until a formal Interim Life Safety Measure, approved by UCD Fire Department is in place.

U. No fumes from the adhesives are to be drawn into the Hospital HVAC system.

1.7 WARRANTY

A. Furnish to University a written guarantee for the single-ply roofing system from the single-ply manufacturer against all defects in materials and workmanship, for 10 years from date of acceptance.

B. Furnish to University a written guarantee for the single-ply roofing system from the Contractor against all defects in workmanship, including without limitation to roofing, flashings, or metal work, for 3 years from date of acceptance.
PART 2 - PRODUCTS

2.1 GENERAL

A. Components of the PVC single-ply fully adhered roof system are to be products on one PVC single-ply manufacturer.

2.2 APPROVED MEMBRANE SYSTEMS

A. Sarnafil G410L, manufactured by Sarnafil Inc., 48 mils nominal (.048") thickness, polyester reinforced membrane with an acrylic coating to repel dirt. Exposed color of PVC membrane shall be gray.

B. Trocal SR-60, manufactured by Trocal Inc., 50 mils nominal (.050") thickness, polyester reinforced membrane with an acrylic coating to repel dirt. Exposed color of PVC membrane shall be gray

C. Or equal, See Section 01 60 00 Product Requirements for procedures to request substitution.

2.3 MEMBRANE

A. Membrane shall conform to ASTM D4434 (LATEST REVISION) Standard for poly (vinyl chloride) sheet roofing. Classification: Type II, Grade I, Color shall be gray.

B. Contractor must provide evidence that Manufacturer has comparable successful systems in place equal to that specified for a minimum of 5 years.

2.4 ACCESSORY PRODUCTS

A. Contractor shall obtain from the PVC single-ply manufacturer the following products:

B. Flashing Membrane: Flashing Membrane shall be as supplied by PVC single-ply manufacturer. Flashing membranes shall be the same material as provided for the roofing membrane without the felt back.

C. Flashing Membrane Adhesive: Adhesive for bonding the flashing membrane to substrates shall be a contact adhesive supplied by the PVC single-ply manufacturer.

D. Walkpads: Polyester reinforced PVC membrane, .096" thick for traffic areas.

E. Clad Metal: .020" thick membrane laminated to 25 gauge galvanized sheet metal.

F. Felt: Non-asphaltic polyester felt used as an asphalt barrier, leveling layer and slip sheet.

G. Welder: Automatic hot air welding apparatus for seaming of sheets.

H. Prefabricated details: Inside/Outside corners or vent stacks (2 - 5" diameters).

I. Solvent Cleaner: Solvent Cleaner for removal of contaminates (adhesives) from the single-ply membrane.

J. Flatbar/turnbar: 14 gauge galvanized steel bar, channel shaped, punched 1" on center.
2.5 RELATED MATERIALS

A. Insulation: where specified or required, insulation shall be installed to form crickets.
   1. Insulation for use in a fully adhered PVC membrane system shall be a Factory Mutual Class I fire rated, I-90 uplift approved board.
   2. Insulation shall meet all identified code requirements.
   3. Insulation shall be approved in writing by insulation manufacturer for intended use, and for use with PVC membrane materials.
   4. Insulation shall be compatible with PVC membrane.

B. The following list of insulation boards are acceptable or equal:
   1. Isocyanurate Insulations:
      a. SarnaTherm II isocyanurate insulation as supplied by Sarnafil, Inc.
      b. SaraTherm I isocyanurate insulation as supplied by Sarnafil, Inc.
      c. Energy I isocyanurate as manufactured by NRG Barriers, Inc.
      d. Isodeck GF isocyanurate as manufactured by Carpenter.
      e. Multi-max isocyanurate as manufactured by R-Max, Inc.
      f. Apache Pyrox isocyanurate as manufactured by Apache Building Products.
   2. Insulation thickness shall be 1" or as required to form crickets identified in the specifications and construction documents.

C. Wood Nailers: Treated wood nailers shall be installed at the perimeter of the entire roof and around such other roof projections and penetrations as specified on the project drawings. Height of the nailers shall be matched to that of the insulation thickness being used.
   1. Wood nailers shall be treated for fire and rot resistance (wolmanized or osmose treated), #2 or better lumber. Creosote or asphaltic-treated lumber is not acceptable.
   2. Wood nailers shall conform to Factory Mutual's Loss Prevention Data 1-49.
   3. All wood shall have a maximum moisture content of 19% by weight on a dry weight basis.

2.6 ACCEPTED FASTENERS FOR ATTACHMENT OF INSULATION

A. The following fastener is approved for steel deck construction:
   1. SFS Isofast IF2 Fasteners with 3" round galvanized plates.

B. Fastener Manufacturer's Warranty:
1. Fasteners and plates shall be Factory Mutual approved and meet F. M. Standard 4470 for corrosion resistance.

2. Fastener manufacturer shall warranty the performance of the fastener and plates for the duration of the warranty.

3. Fastener and plates shall be approved in writing by fastener manufacturer for intended use, and for use with manufacturer's products.

2.7 WALKWAYS

A. Walkways shall consist of the following:

1. Polyester reinforced PVC membrane .096" thick fully adhered to membrane. Only manufacturers walkways are permitted; i.e. SarnaTread or equal.

2.8 SEALANTS

A. The following caulking/sealants are accepted based on chemical compatibility with PVC single-ply membranes: TREMCO, Monolastomeric, one-part acrylic, Dow Corning/General Electric Co., Silpruf, one-part silicone sealant, Gates Engineering Co., GACO AS-3 one-part acrylic, or equal.

2.9 MISCELLANEOUS FASTENERS AND ANCHORS

A. All fasteners shall be of the same type as metal being secured. In general, all fasteners, anchors, nails, straps, shall be of zinc or cadmium plated steel, galvanized, or stainless steel. All fasteners and anchors shall have a minimum embedment of 1-¼” and shall be approved for such use by the fastener manufacturer. Fasteners for attachment of metal to wood blocking shall be annular ring nails. Fasteners for attachment of metal to masonry shall be expansion type fasteners. All fasteners shall meet Factory Mutual Standard 4470 for corrosion resistance.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall coordinate the installation so that each area is made watertight at the end of each work period.

3.2 SUBSTRATE PREPARATION

A. A proper substrate shall be provided to receive the PVC single-ply fully adhered membrane system.

B. The roofing Contractor shall inspect the roofing surface for defects such as excessive surface roughness, contaminated surfaces, structurally unsound substrates, etc., that will adversely affect the quality of work and prep areas as required to receive membrane/felt back system.

C. The substrate shall be clean, smooth, dry, free of flaws, sharp edges, loose and foreign material, oil and grease. Roofing shall not start until all defects have been corrected.

D. All roof surfaces shall be free of water, ice and snow.
3.3 INSTALLATION OF PVC SINGLE-PLY MEMBRANE

A. General

1. Over the properly prepared substrate surface, manufacturer approved contact adhesive shall be applied using recommended solvent resistant ¾” nap paint rollers, the adhesive shall be applied at a rate of approximately ¾ to 1-⅜ gallons per 100 square feet depending on the substrate being adhered to. The Contractor shall use the rate specified by the manufacturer. The adhesive shall be applied in a smooth, even coating with no holidays, globs, puddles, or similar irregularities. Only an area which can be completely covered in the same day's operations shall be coated with adhesive. The adhesive shall be allowed to dry completely prior to installing the membrane.

2. When the adhesive on the substrate is dry, a second coat of adhesive will be applied, the 18 oz. felt back or membrane will be rolled into the fresh adhesive. Immediately after placing the membrane, the entire surface area must be rolled with a foam covered water-filled lawn roller.

3. No bonding adhesive shall be applied in lap areas. All sheets shall be applied in the same manner, lapping all sheets as required by hot air welding techniques.

B. FM-90 System Perimeter and Corners

1. Over the properly installed and prepared substrate surface, PVC single-ply membrane half sheets are to be installed around the entire perimeter edge, per manufacturers’ recommendations.

3.4 HOT AIR WELDING OF LAP AREAS

A. General:

1. Adjacent sheets shall be welded in accordance with PVC single-ply manufacturers' written instruction. All side and end lap joints shall be hot-air welded. Lap areas shall be a minimum of 3” wide when machine welding, and a minimum of 4” wide when hand welding.

2. Welding equipment shall be obtained from or approved by PVC manufacturer. All mechanics intending to use the equipment shall have successfully completed a course of instruction provided by PVC manufacturer’s representative prior to welding.

3. All surfaces to be welded shall be clean according to PVC manufacturer recommendations, and dry. No adhesive shall be present within the lap areas.

B. Hand Welding: Hand welded seams shall be completed in three stages. Equipment shall be allowed to warm up for at least one minute prior to start of welding.

1. The lap shall be tack welded every 3 feet to hold the seam in place.

2. The back edge of the lap shall be welded with a thin, continuous weld to prevent loss of hot air during the final welding.

3. The hot air nozzle, shall be inserted into the lap at a 45º angle. Once the proper welding temperature has been reached and the material starts to flow, the hand
roller shall be applied at a right angle to the welding gun and pressed lightly. For straight laps, the 1-½” wide nozzle shall be used. For corners and compound connections, the ¾” wide nozzle shall be used.

C. Machine Welding: Machine welded seams may be achieved by the use of PVC manufacturers’ various automatic welding equipment. When using this equipment, the manufacturer’s instructions shall be followed and local codes for electric supply, grounding and over current protection observed. The automatic welding machines require 218 to 230 volts at 3040 amps. The use of a portable generator is recommended.

D. Quality Control of Welded Seams: all completed welded seams shall be checked by the Contractor after cooling for continuity using a rounded screwdriver or other suitable blunt object. Visible evidence that welding is proceeding acceptably is smoke during the welding operation, shiny membrane surfaces, and an uninterrupted flow of black material from the edge of completed joints. On-site evaluation of welded seams shall be made daily by the Contractor to locations as directed by the University’s Representative or Manufacturer’s Representative. Two-inch wide cross-section samples shall be taken three times a day minimum through completed seams. Correct welds display failure from shearing of the membrane prior to separation of the weld. Each testy cut shall be patched by the Contractor at no extra charge to the University.

3.5 INSULATION INSTALLATION

A. General Criteria:

1. Install Insulation in accordance with manufacturer’s instructions.

2. Insulation shall be neatly cut to fit around penetrations and projections.

3. Fully adhere insulation to form crickets where stipulated with contact adhesive. PVC single-ply membrane to be fully adhered to insulation.

4. Install Tapered Insulation around drains creating a drain sump.

5. Do not install more Insulation than can be covered with membrane by the end of the day, or onset of inclement weather.

6. Mechanical Attachment

a. FM I-90 Approved Perimeter Fastening Pattern-Insulation panels which fall in the perimeter and corner areas of the building shall be fastened at a minimum rate of six fasteners for every 4’ x 8’ insulation panel, or according to the insulation manufacturer’s requirements, whichever is more stringent. The perimeter area shall be defined as the strip of the roof around the outside perimeter of the building having a width defined by the least of the following parameters: 1) 10% of the building length; 2) 10% of the building width; 3) 40% of the building height. In any case, the perimeter width shall not be less than 4’.

b. Fasteners are to be installed in accordance with fastener manufacturer’s recommendations. Fasteners are to have minimum penetration into structural deck recommended by fastener manufacturer and PVC manufacturer.
c. Use fastener tools with a depth location as recommended or supplied by fastener manufacturer to ensure proper installation.

d. Provide pullout tests to verify deck condition and actual pullout values. Provide data to Architect and University's Representative.

B. Fully adhere insulation to form crickets where stipulated with contact adhesive. PVC single-ply membrane to be fully adhered to insulation. Contractor may form crickets with treated plywood as an alternative and then fully adhere membrane over.

3.6 WOOD NAILERS INSTALLATION

A. Install continuous treated wood nailers at the perimeter of the entire roof and around roof projections and penetrations as specified on the project drawings.

B. Nailers shall be anchored to resist a minimum force of 175 pounds per linear foot in any direction. A ½” space shall be provided between nailer lengths. Individual nailer lengths shall not be less than 3’ long. Fasteners spacing shall be a maximum of 3’ on center. Fasteners shall be installed within 6” of each end. Spacing and fastener embedment shall conform to Factory Mutual Loss Prevention Data 1-49.

C. Thickness shall be as required to match substrate or insulation height/

D. Any existing woodwork which is to be reused shall be firmly anchored in place (shall resist a minimum force of 175 pounds per linear foot in any direction) and free of rot. Only woodwork designated to be reused in detail drawings shall be left in place and all other woodwork shall be removed.

3.7 WALKWAY INSTALLATION

A. Walkways shall be provided for regular maintenance of rooftop equipment and for roof areas subject to foot traffic.

1. Roofing membrane to receive walk pads shall be clean and dry.

2. Chalk lines on deck sheet to indicate location of walk pads.

3. Walk pad shall be unrolled and positioned within chalk lines.

4. Hot-air weld the perimeter of the walk pad to the PVC membrane deck sheet. Check all welds with a rounded screwdriver. Reweld any inconsistencies.

3.8 MEMBRANE FLASHINGS

A. All flashings shall be installed concurrently with the roof membrane as the job progresses. No temporary flashings shall be allowed without the prior written approval of the University's Representative. Approval shall only be for specific locations on specific dates. Flashings shall be adhered to compatible, dry smooth, and solvent-resistant surfaces.

B. Contact Adhesive for Flashings

1. Over the properly installed and prepared substrate surface, contact adhesive shall be applied using approved solvent-resistant ¾” nap paint rollers. The adhesive shall be applied in smooth, even coatings with no holidays, globs,
puddles or similar irregularities. Only an area which can be completely covered in the same day's operations shall be coated with adhesive. The surface with adhesive coating shall be allowed to dry completely prior to installing the membrane.

Note: Drying time increases with cooler temperature. Also, the Contractor is cautioned against work on days of high humidity because of extremely slow evaporation of the solvent. The contractor shall check with the PVC manufacturer's technical representative prior to roof operations on such days.

2. When the surface is dry, the PVC flashing membrane is cut to a workable length and the underside shall be evenly coated with contact adhesive at a rate of ½ gallon per 100 sq. ft. When the adhesive had dried sufficiently to produce strings when touched with a dry finer, the coated membrane shall be rolled onto the previously-coated substrate being careful avoid wrinkles. Do not allow adhesive on the underside of the membrane to completely dry. The amount of membrane that can be coated with adhesive before applying to substrate will be determined by ambient temperature, humidity, and manpower. Adjacent sheets shall be overlapped a minimum of 4”. Flashings shall extend 5” onto the roofing membrane. The bonded sheet shall be pressed firmly in place with a hand roller.

3. No bonding adhesives shall be applied in lap areas that are to be welded to flashing or adjacent sheets. All sheets shall be applied in the same manner, lapping all sheets as required by welding techniques.

C. All flashings shall extend a minimum of 8” above roofing level unless previously accepted by University's Representative.

D. All flashing membranes shall be fully adhered to substrates. All interior and exterior corners and miters shall be cut and hot-air welded at their joints and at their connections with the roof membrane.

E. All flashings shall be hot-air welded at their joints and at their connections with the roof membrane.

F. All flashing membranes shall be mechanically fastened along the tip edge through tin discs spaced a maximum of 1’ on center, or pre-drilled metal strips where so specified in the specifications. Expansion pins with nylon sheaths set in pre-drilled holes shall be used to secure flashings to masonry and concrete surfaces.

3.9 METAL FLASHINGS

A. Metal details, fabrication practices and installation methods shall conform to the applicable requirement of the following:

1. Factory Mutual Loss Prevention Data Sheet 1-49 (latest issue).

2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA), (latest issue).

B. Complete all metal work in conjunction with roofing and flashings so that a watertight condition exists daily

C. Metal shall be installed to provide adequate resistance to bending and allow for normal thermal expansion and contraction.
D. Metal joints shall be watertight.

E. Metal flashings shall have a 4” minimum nailing flange and shall be fastened into solid wood blocking with fasteners of the same type with two rows of annular ring nails, 4” on center, staggered. Fasteners shall penetrate the wood nailer a minimum of 1-¼”.

3.10 TEMPORARY CUT-OFF

A. All flashings shall be installed concurrently with the roof membrane in order to maintain a watertight condition as the work progresses. When a break in the day's work occurs in the central area of a roof, a temporary waterstop shall be constructed to provide a 100% watertight seal. The new membrane shall be carried into the waterstop. The waterstop shall be sealed to the deck and/or substrate so that water will not be allowed to travel under the new or existing roofing. The edge of the membrane shall be sealed in a continuous heavy application of roof cement of 6” girth. When work resumes, the contaminated PVC membrane shall be cut out. All sealant, contaminated membrane, insulation fillers, etc., shall be removed from the work area and disposed of off site. None of these materials shall be used in the new work.

B. If inclement weather occurs while a temporary waterstop is in place, the Contractor shall provide the labor necessary to monitor the situation to maintain a watertight condition.

C. If any water is allowed to enter under the newly-completed roofing, the affected area shall be removed and replaced at the Contractor's expense.

3.11 COMPLETION

A. Prior to demobilization from the site, the work shall be reviewed by the University's Representative and Contractor. All defects noted, non-compliance with the specifications or the recommendation of University's Representative shall be itemized in a punch list. These items must be corrected immediately by the Contractor prior to demobilization to the satisfaction of the University's Representative.

B. All warranties, as required in Section 01 78 00 – Closeout Submittals of this specification shall be submitted for approval prior to final payment.

C. Contractor shall perform a flood test at the completion of the work to demonstrate the watertight integrity of the finished product to the satisfaction of the University's Representative.

D. Inspections by UCD Fire Department must be completed and the job finalized as a condition of completion.

END OF SECTION 07 50 00
SECTION 07 60 00
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 DESCRIPTION:
   A. Scope: Work under this Section shall include all materials and installation necessary to provide Flashing and Sheet Metal, as shown and detailed on the drawings and specified herein.
   B. Related Work Specified Elsewhere:
      1. Section 05 50 00 – Miscellaneous Metal Fabrications
      2. Section 09 91 00 – Painting

1.2 QUALITY ASSURANCE
   A. References:
   B. Qualifications: Installer specializing in the work of this Section with minimum three (3) years documented experience; manufacturer approved.

1.3 SUBMITTALS
   A. General: Refer to Section 01 33 23 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
   B. Shop Drawings: None required for specified products; required for alternate products.
   C. Samples: If specifically requested.
   D. Product Data: None required for specified products; required for alternate products.

1.4 PRODUCT HANDLING
   A. General: Refer to Section 01 31 00 – COORDINATION.
   B. Storage: Stack preformed material to prevent twisting, bending or abrasion; slope to ensure drainage.

1.5 MAINTENANCE
   A. General: Refer to Section 01 77 00 – CLOSEOUT PROCEDURES
   B. Guarantee: Provide in required form for a period of two (2) years from date of final acceptance by University.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Sheet Material:
   1. Galvanized Sheet Metal: ASTM A446, Grade A, G90 zinc coating; 24 gage minimum, core steel.

B. Fasteners:
   1. Nails:
      b. Steel Nails: Hot-dipped galvanized, annular thread, size as required.
      c. Concrete Nails: Flat head, size as required.
      d. Aluminum Nails: Annular thread, size as required.
   2. Rivets: ⅛" diameter; solid type.
   3. Washers: Lead or neoprene, where required.
   4. Lead Plugs: Size as required.

C. Solder:
   2. Flux: FS O-F-506.

D. Galvanizing Repair Treatment:
   1. Rod: Per ASTM A780.
   2. Coating: Per MIL-P-46105.

E. Protective Coatings:
   1. General: FS TT-C-494, Type II; bituminous.

F. Plastic Cement: FS SS-C-153, Type I; asphaltic.

G. Sealing Tape:
   1. No. 606 Architectural Sealant Tape as manufactured by Protective Treatments, Inc.,
2. Or equal, no known equal.

H. Sealants: FS TT-S-230, non-hardening, non-sagging.

2.2 COMPONENTS

A. Premanufactured Copings:

1. Manufacturers:
   a. W.P. Hickman Systems, Inc.
   b. Tremco.
   c. Metal Era.
   d. Permatite.
   e. Substitutions: Under provisions of Division 01.

2. Copings: Modular Coping System.
   a. Coping shall be 0.050 thick aluminum with smooth surface.
   b. Sizes as required to accommodate varying wall thicknesses.
   c. Splice joints shall have 6 inch long concealed splice plates at 12 feet on center. Allow 1/4 inch at all butt joints per 12 foot length.
   d. Prefabricated corners shall be shop mitered and shop welded.
   e. All fasteners shall be concealed.
   f. Finish: Pre-finished with Kynar 500 three coat paint system in conformance with AAMA 2605, color as selected by Architect.

B. Premanufactured Roof Penetration Flashings:

1. Pipe Portal System as manufactured by Portals Plus or accepted equal. Product:
   a. Pipe Boots: Compression molded EPDM rubber caps mechanically sealed to curb cover using two beads formed into the collar of the cover mated with double grooves molded into the inside of the cap. Provide manufacturer’s standard adapter rings as required for a watertight installation. Size and type: As required for size and number of pipes to be flashed.
      1) Provide stainless steel clamps for final securement of pipe boots around penetrations.
2.3 FABRICATION

A. Manufacture:
   1. General: Form sections, per referenced standards, true to shape, accurate in size, square, and free from distortion or defects. Form pieces in single length sheets, not to exceed 10'-0" in length. Hem exposed edges on underside ½"; miter and seam corners.
   2. Seams: Flat lock.
   3. Corners: One piece with minimum 18" long legs; solder for rigidity, seal with sealant.
   5. Vertical Faces: Bottom edge formed outward ¼" and hemmed to form drip.
   6. Flashing Toe: Extend toe 2" over roofing; return and brake edges.
   7. Soldering: Solder shop formed metal joints. After soldering, remove flux; wipe and wash solder joints clean. Weather seal joints.

B. Assemblies:
   1. General: Fabricate with galvanized sheet metal, unless otherwise shown.
   2. Flashing:
      a. Exterior Hollow Metal Frame Flashing: 18 gages, as shown.
      b. Gravel Stops: Form corners with interlocking joint, soldered and ground smooth.

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. General: Install in conformance with referenced standards, manufacturer's written directions, as shown, and as specified.
B. Underlayment: Apply one (1) layer of felt underlayment over surfaces as shown; lap all edges 6” minimum, in direction of slope.

C. Application:
   1. General: Make corners square, surfaces true and straight in planes, and lines accurate to profiles. Fit sheet metal tight in place; secure using concealed fasteners. Apply plastic cement compound between metal flashings and felt flashings. Seal metal joints watertight.
   2. Expansion and Contraction: Allow for expansion and contraction over an ambient temperature range up to 150°F; distortions resulting from fastening or expansion and contraction stresses not acceptable
   3. Dissimilar Metals: Isolate with heavy coat of bituminous paint. Coat all sheet metal in contact with roofing felts.

D. Components: Install as shown; set flashing to form watertight fit.

E. Assemblies:
   1. Flashing:
      a. General: Install flashings where shown; miter and solder joints at corners. Lap joints in counterflashing at least 6” and make watertight with sealing tape. Extend counterflashing down not less than 6”.
      b. Exterior Hollow Metal Frame Flashing: Provide at frame heads, as shown.
      c. Gravel Stops: Set on top of roofing felts in ¾” thick bed of plastic cement, with laps filled; close ends at scuppers.

F. Sealants: As shown; per manufacturer's directions.

G. Galvanizing Repair Treatment: Repair damaged zinc coating with specified repair compound, as required.

3.3 CLEANING

A. General: Keep premises free from accumulation of waste and rubbish. At the completion of work remove surplus materials, rubbish, and debris and thoroughly clean exposed surfaces.

END OF SECTION 07 60 00
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Prefabricated roof hatch, with integral support curb, operable hardware and counter-flashings.

B. Roof hatch guard.

1.2 RELATED SECTIONS

A. Section 05 31 00 – Steel Decking.

B. Section 05 50 00 – Miscellaneous Metal Fabrications

C. Section 07 50 00 – Single Ply Roofing.

D. Section 07 60 00 – Flashing and Sheet Metal.

1.3 SUBMITTALS

A. Submit under provisions of Division 01.

B. Product Data: Provide data on unit construction, sizes, configuration, jointing methods and locations, and attachment method.

C. Manufacturer’s Installation Instructions: Indicate special installation criteria, interface with adjacent components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Bilco, Product:

1. Roof Hatch:

   a. Model: Type NB 30 inch x 54 inch single leaf.

2. Roof Hatch Guards:

   a. Model: Bil-Guard 2.0 RL2-NB 30 x 54.

B. Nystrom.

C. Babcock – Davis.

D. Milcor.

E. Substitutions: Under provisions of Division 01.
2.2 ROOF HATCHES

A. Unit: 30 inches by 54 inches size, single leaf type.

1. Performance Characteristics:
   a. Cover shall be reinforced to support a minimum live load of 40 pounds per square foot with a maximum deflection of 1/150th of the span and 20 pounds per square foot wind uplift.
   b. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
   c. Operation of the cover shall not be affected by temperature.
   d. Entire hatch shall be weathertight with fully welded corner joints on cover and curb.

2. Cover: 14 gauge galvannealed steel with a 3 inch beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.

3. Cover Insulation: Fiberglass of 1 inch thickness.

4. Curb: 12 inch height, 1 gauge, galvanized steel.

5. Curb Insulation: Rigid, high-density fiberboard of 1 inch thickness on outside of curb.

6. Lifting Mechanisms: Provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.

7. Hardware:
   a. Heavy pintle hinges.
   b. Cover shall be equipped with a spring latch with interior and exterior turn handles, and a safety pull down handle.
   c. Roof hatch shall be equipped with interior and exterior padlock hasps.
   d. The latch strike shall be a stamped component bolted to the curb assembly.
   e. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1 inch diameter red vinyl grip handle to permit easy release for closing.
f. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be Type 316 stainless steel.

g. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.


2.3 ROOF HATCH GUARDS

A. Performance Characteristics:

1. High visibility safety yellow powder coat finish.

2. Hatch rail system shall attach to the cap flashing of the roof hatch and shall not penetrate any roofing material.

3. Hatch rail system shall satisfy the requirements of OSHA 29 CFR 1910.23 and shall meet OSHA strength requirements with a factor of safety of two.

4. UV and corrosion resistant construction with a five year warranty.

5. Self-closing gate shall be provided with hatch rail system.

B. Posts and Rails: Shall be 1.25 inch 6061 aluminum Schedule 40 pipe.

C. Hardware: Mounting brackets shall be 3/8 inch thick extruded aluminum. Hinges and post guides shall be 6063-T5 aluminum. Fasteners shall be hex head bolts 3/8 inch - 16 x 3/4 inch stainless steel.

2.4 FABRICATION

A. Fabricate components free of visual distortion or defects. Weld corners and joints.

B. Provide for removal of condensation occurring within components or assembly.

C. Fit components for weathertight assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof hatches, roof hatch guards, in accordance with manufacturer's instructions.

B. Coordinate with installation of roofing system and related flashings for weathertight installation.

C. Apply bituminous paint on surfaces of units in contact with cementitious materials or dissimilar metals.

D. Test units for proper function and adjust until proper operation is achieved.
3.2 CLEANING

A. Clean exposed surfaces using methods acceptable to the manufacturer which will not damage finish.

END OF SECTION
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. Standard density gypsum-based cementitious 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 01730 – Cutting and Patching.

B. Section 05 12 00 – Structural Steel.

C. Section 07 81 23 – Intumescent Mastic Fireproofing.

D. Divisions 21 - 23 – Mechanical.

E. 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:


1.04 SUBMITTALS

A. Submit all information under provisions of Section 01330.

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 01330 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 01330.

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:


   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 01610.

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 01610.

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 15 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 200 pounds per square foot.

5. Air Erosion: Maximum allowable weight loss of the fireproofing material shall be 0.000 grams per square foot, and no continued erosion after 4 hours 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 8.3 pounds per square inch 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. 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.

9. Mold Resistance: Fireproofing material shall be tested in accordance with ASTM G21 and shall show resistance to mold growth for a period of 28 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.

2.03 ACCESSORIES

A. Metal Lath: Expanded metal flat diamond weighing 3.4 pounds per square yard with galvanized finish as manufactured by ClarkDietrich Building Systems, Cemco, Amico, or accepted equal.

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.
1. Securely attach lath to framing members with mechanical fasteners. Lap edges of lath a minimum of 2 inches.

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. 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.

C. 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.

D. 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. Intumescent fire protection material.
B. Topcoat protective decorative finish.

1.2 RELATED SECTIONS
A. Section 05 12 00 – Structural Steel Framing.
B. Section 05 50 00 – Metal Fabrications: Primer receiving fire protection materials.
C. Section 07 81 16 – Cementitious Fireproofing.
D. Section 07 84 00 – Firestopping.
E. Section 09 91 00 – Painting.

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:
   3. Intertek Testing Services Certification Listing.
   4. SSPC Surface Preparation Standards.
   5. UL List of Equipment and Materials.

1.4 SUBMITTALS
A. Submit product data under provisions of Division 01.
B. Manufacturer’s Data: Submit manufacturer’s specifications, including certification as may be required to show material compliance with contract documents.
C. Test Data: Submit certified copies of test designs from nationally certified testing laboratory.

D. Application Instructions: Submit manufacturer’s application instructions.

1.5 SYSTEM DESCRIPTION

A. The intumescent fire protection materials shall be applied at the thickness required to provide the fire resistance ratings indicated on Drawings.

1.6 QUALITY ASSURANCE

A. Manufacturer – Company specializing in manufacturing products of this Section.

B. Applicator – A firm with expertise in the installation of fire protection or similar materials. This firm shall be approved by the fire protection material supplier.

C. Product – The system shall be on the approved list of the Office of the California State Fire Marshal, and accepted by the Architect and other applicable authorities having jurisdiction.

D. Single Source Responsibility: Provide primer, intumescent fire protection material, and topcoat decorative coating from a single manufacturer to ensure system compatibility and quality, and to comply with manufacturer’s warranty requirements.

E. Compatibility and Adhesion Testing: Engage a qualified testing and inspecting agency to test for compliance with requirements for specified performance and test methods.


2. Verify that manufacturer, through its own laboratory testing or field experience, has not found primers or coatings to be incompatible with intumescent mastic fireproofing materials.

F. Fire-Test-Response Characteristics: Provide intumescent mastic fireproofing materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify bags containing intumescent mastic fireproofing materials with appropriate markings of applicable testing and inspecting agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from listings of another testing and inspecting agency acceptable to authorities having jurisdiction, for intumescent mastic fireproofing materials serving as direct-applied protection tested per ASTM E119.


1.7 DELIVERY, STORAGE AND HANDLING
A. Deliver materials to the project in manufacturer’s unopened packages, fully identified as to trade name, type, and other identifying data. Packaging shall bear the ULI or ITS labels and seals for fire resistance ratings.

B. Store materials at a temperature above 40 degrees F in a dry location, protected from the weather.

C. Damaged packages found unsuitable for use and any materials which have come into contact with contaminants prior to use shall be rejected and removed from the project.

1.8 PROJECT/SITE CONDITIONS

A. When the temperature at the job site is less than 40 degrees F, a minimum substrate and ambient temperature of 40 degrees F shall be maintained prior to, during, and a minimum of 24 hours after application. If necessary to maintain job schedule, provide enclosures and heat to maintain proper temperatures and humidity levels in the application areas.

B. Provide normal and or mechanical ventilation to allow proper drying of the intumescent and to ensure that a safe working area is achieved, during and after application.

C. In enclosed areas, ventilation shall not be less than three complete air exchanges per hour.

D. Intumescent fire protection shall not be applied until concrete toppings and or roofing applications have been installed.

E. Relative humidity shall not exceed eighty percent throughout the total period of application and drying for the intumescent fire protection material, and must not exceed eighty percent throughout the application and drying for the protective decorative finish coat.

1.9 SEQUENCING AND SCHEDULING

A. Schedule under provisions of Division 01.

B. Applicator shall cooperate in the coordination and scheduling of fire protection work to avoid delays in job progress.

C. The installation of piping, ducts, conduit, or other suspended equipment shall not commence until the application of the sprayed fire protection is complete in that area.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS


D. AD Fire Protection Systems Inc. Product: Firefilm III.
F. Substitutions: Under provisions of Division 01.

2.2 PRIMER
A. Primer shall be approved by the intumescent fire protection manufacturer and applied in full accordance with the primer manufacturer's written instructions.

2.3 INTUMESCENT FIRE PROTECTION SYSTEM
A. Intumescent fire protection material shall be applied in accordance with drawings and specification, and shall have been tested, in accordance with nationally certified testing laboratory and reported by Underwriter's Laboratories or Intertek Testing Services.

2.4 TOPCOAT DECORATIVE COATING
A. Topcoat materials for finish color coat shall be as supplied by intumescent fire protection system manufacturer. Color as selected by Architect.

PART 3 - EXECUTION

3.1 PREPARATION
A. All surfaces to receive fire protection material shall be clean, dry, and free of oil, grease, loose mill scale, dirt, dust, or other materials, which would impair bond of the fire protection material to the surface.
B. Confirm compatibility of surfaces to receive fire protection material. Steel surfaces shall be primed with a compatible primer recommended by the fire protection material manufacturer.
C. All unsuitable substrates must be identified and made known to the Architect and corrected prior to the application of the fire protection material.
D. The application of fire protection material shall not commence until certification has been received by the Contractor that all surfaces to receive fire protection material have been inspected by the applicator and are acceptable to receive fire protection material.
E. Provide masking, drop cloths, or other suitable coverings to prevent over spray onto surfaces not intended to be sprayed.

3.2 MOCK UP
A. Before proceeding with the work, the applicator shall apply the fire protection material to a section as a mock up. This section shall be witnessed by the Architect for acceptance and used as a guide for texture, and thickness of the finish work.

3.3 APPLICATION
A. Equipment and application shall conform to the manufacturer's written application instructions.
B. The fire protection material shall be applied in sufficient thickness to achieve the required fire resistance rating with as many passes as necessary.

C. The fire protection material and the topcoat decorative finish shall be applied by spray, brush, or roller in field.

D. Topcoat shall be applied according to the manufacturer's recommendations.

E. Proper temperature and ventilation shall be maintained as specified in this Section.

3.4 CLEAN UP AND REPAIR

A. The work area shall be maintained in an orderly condition.

B. After the completion of work, equipment shall be removed and all surfaces not to be sprayed shall be cleaned to the extent previously agreed to by the applicator and the Contractor.

C. Upon completion of installation, all excess material, over spray, dropping and debris shall be cleared and removed from the job site.

D. All patching of and repair to fire protection material, due to damage by other trades, shall be performed under this Section and paid for by the trade responsible for the damage.

3.5 INSPECTION AND TESTING

A. In addition to continuous wet film thickness checks performed by the applicator during application, the installed intumescent shall be inspected by a qualified independent testing laboratory for thickness in accordance with the SSPC Dry Film Thickness Testing.

B. The results of the above tests shall be made available to all parties at the completion of each area and approved prior to the application of topcoat.

END OF SECTION 07 81 23
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 safin 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:

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:
   1. STI. 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. 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
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. Exterior Joints:

1. Vertical Surfaces: Non-sag polyurethane; by Dymeric or equal.

2. Precompressed Expanding Sealant Tape:
   a. PC-SA manufactured by Emseal Joint Systems, Ltd.
   b. Pecora Chemical Corp., or equal.

3. Horizontal Paving Joints: Self-leveling polyurethane; THC 900; interior and exterior.

C. Interior Joints: Acrylic Latex.

D. Joint Cleaner: Provide cleaner recommended by sealant manufacturer for specific joint surface and condition.

E. Joint Primer and Sealer: As recommended by sealant manufacturer for each condition.

F. Bond Breaker Tape: Pressure sensitive polyethylene tape.

G. 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 ¼ 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
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Rated and non-rated expansion joint assemblies for wall and soffit surfaces.

1.2 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete.
B. Section 05 40 00 – Cold-Formed Metal Framing.
C. Section 07 92 00 – Joint Sealants.
D. Section 09 22 16 – Non-Structural Metal Framing.
E. Section 09 29 00 – Gypsum Board.

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:


1.4 SUBMITTALS

A. Submit under provisions of Division 01.
B. Product Data: Provide joint assembly profiles, dimensions, locations in the Work, affected adjacent construction, anchorage devices, available colors and finish, and locations of splices.

C. Manufacturer’s Installation Instructions: Indicate rough-in sizes. Provide templates for cast-in or placed frames or anchors, and indicate tolerances for item placement.

1.5 QUALITY ASSURANCE

A. Manufacturer: Sufficient experience specializing in the manufacturing of expansion joint assemblies utilizing membrane seals.

B. Application: Factory approved, trained and certified in the proper installation of the specified expansion control system.

C. Fire rated joints shall meet or exceed CBC 714.3, ASTM E1966 and UL 2079 requirements. Fire rating shall be not less than the fire rating of adjacent construction.

1.6 FIELD MEASUREMENTS

A. Verify that field measurements are as instructed by the manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver products in each manufacturer’s original, intact, labeled containers, pallets or bundles and store under shelter in a dry location with temperatures above 40 degrees F until installed. Store off the ground, protect from freezing, direct sun exposure in elevated temperatures and construction activities.

1.8 WARRANTY

A. The expansion system shall be warranted for a period of three years for normal usage under specified movements and design conditions.

B. The three year warranty shall warrant and provide at no charge, all materials and labor needed to properly repair or replace defective or damaged product within the term of the provided warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Construction Specialties. Product: Model #SC2000

B. Nystrom. Product: Model #FLF/W.

C. Balco, Inc.

D. MM Systems Corporation.

E. Watson Bowman Acme.

F. InPro Corporation.
G. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Extruded Aluminum: ASTM B221; 6063-T5 alloy for extrusions.
C. Threaded Fasteners: Aluminum or stainless steel.
D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187.
F. Ceiling Joints: Extruded Santoprene, Grade 221-73 colorable. Color as selected by Architect.
G. Fire Barrier: Single package membrane type; Nystrom Fireline Series 2 hour fire barrier or accepted equal.
H. Flame Sealant: Per manufacturer’s recommendations. Sealant shall, upon exposure to heat, increase in volume to resist penetration of fire through voids in construction.
I. Provide 45 mil flexible EPDM Class I (per ASTM D4637) water barriers with drainage fittings and tubing at exterior joints for a waterproof installation.

2.3 FABRICATION

A. Joint Covers: Aluminum cover plate, aluminum frame construction, retainers with resilient filler strip, designed to permit ±100 percent joint movement with full recovery, flush and recess mounted; refer to drawings for types and locations.
B. Back paint components in contact with cementitious materials with bituminous coating.
C. Shop-assemble components and package with anchors and fittings. At metal components, provide factory welded transitions and corners.
D. Provide joint components in single length wherever practical. Minimize site splicing.
E. Only straight, butt splice connections shall be allowed on the jobsite following manufacturer’s written instructions utilizing specialty heat fusing equipment or the manufacturer’s specialty splicing adhesive. All factory and field fused connections shall incorporate bonding of the complete seal profile. This includes fusing of all internal and external web configurations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions prior to installation.
B. Verify that joint preparation and affected dimensions are acceptable.

3.2 PREPARATION
A. Provide anchoring devices for installation and embedment.
B. Provide templates and rough-in measurements.

3.3 INSTALLATION

A. Install components and accessories in accordance with manufacturer's instructions.
B. Align work plumb and level, flush with adjacent surfaces.
C. Rigidly anchor components to substrate to prevent misalignment.
D. Make allowances for change in joint size due to difference between installation and building operating temperatures.
E. Install fire rated barriers to requirements of fire rated design.
   1. Single package fire barriers shall be installed on both sides of joint.
   2. Double package fire barriers shall be installed from one side of joint.
F. Cover and protect expansion joint cover assemblies from construction traffic.
G. Interior Joints: Secure joint assembly in place with anchors spaced at 24 inches on center maximum.
H. Exterior Expansion Systems: Mechanically fasten frames to each side of joint and attach interior and exterior seals and water barrier systems.
I. Roof Joint Covers: Attach to curbs and substrates at 24 inches on center maximum.
J. Remove excess and misplaced sealants as work progresses.
K. Remove protective film or coverings from expansion joint covers upon completion of adjacent construction.

3.4 ADJUSTING AND PROTECTION

A. Adjust joint seal to freely accommodate joint movement.
B. Protect installation from damage by work of other Sections.

END OF SECTION 07 95 00
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 Laboratory (UL) or Warnock Hersey (WH).

2. Provide re-certification for altered rated doors and frames.

B. Design Requirements: Exterior glazed frame members designed to withstand a wind load of 24 lbs. per square foot, minimum.

C. Reference Standards:

1. Accessibility Requirements:
   a. General: Comply with requirements of the Americans with Disabilities Act.


   a. ASTM A666: Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

5. National Fire Protection Association (NFPA):
   b. NFPA 101; Life Safety Codes.

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. Stainless Steel:
   1. Type 304 stainless steel with satin finish conforming to ASTM A666 and NAAMM/HMMA 866 specifications.

C. 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.

D. Silencers: Resilient rubber; manufacturer's standard.
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:
   b. Exterior (Thermally Broken; Insulated): SDI-100 Grade II, Model 2.
   c. Interior (Non-rated): SDI-100 Grade II, Model 1.
   d. Interior (Fire Rated): SDI-100 Grade II, Model 2.
   e. Interior (Acoustic): 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.
      4) Sound Rated: STC of 50, measured in accordance with ASTM E413.

3. Accessories:
   a. Louvers: Model No. AFDL.
   b. Vision Light Frames: Model No. BFL-75; glass and glazing per Division 8 "Glass and Glazing" as shown.
   c. Fasteners: Manufacturer's standard; tamperproof.

4. Astragals: 1/8” 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. Exterior: 14 gauge, galvanized.

2. Interior Frames: 16 gauge; 14 gauge for frames over 3'-0" wide or fire rated. Provide hospital stops.
   a. Provide 14 gauge stainless steel frames where indicated on Drawings.

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. Close top and bottom edge of exterior doors with flush end closure. Seal joints watertight.
   b. Stile and Rail Doors: Provide where shown with internal continuous channel reinforcement; furnish plain square-type removable glazing beads secured to frame with countersunk screws spaced not more than 12" on center.
   c. Dutch Doors: Fabricate as specified for flush doors. Provide shelf with boxed edges and closed ends; fabricate from 16 gauge galvanized steel sheet. Support shelf on door manufacturer's standard steel brackets, unless otherwise shown.
   d. 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. Glazed and Louvered Openings: As shown.

4. 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 than six spot welds.

5. Door Clearances: Provide 3/4" maximum clearance at jambs, heads, and meeting stiles; threshold clearances as specified under Section 08 71 00 "Finish Hardware".

6. 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.
   c. Drywall Frames: Drywall slip-on type.

2. Fire Rated Frames: Fabricate as specified for standard metal frames permanently attach fire-rating label to frame.

3. Glazed Lights:
   a. General: As shown; provide applied stops as required.
   b. Transom Bars: Fixed type, of same profiles as jamb and head.

4. 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.

5. Stops:
   a. Applied Stops: Rolled steel shape, mitered corners, prepared for counter-sink 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 45° angle and close.

6. Mullions for Double Doors: Fixed type, of same profiles as jambs.

7. 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.

8. Sound Deadening: Coat inside (concealed) faces of doorframes in hollow wall construction. Apply emulsion over shop primer ¼” thick and dry thoroughly before handling.

C. Anchors:

1. General: Fabricate 16 gauge x 2” wide anchors of same material used for door frames.

2. Metal Stud Partitions: Metal stud 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. Frames Set in Metal Stud Partitions:
      1) General: Weld to frames and studs.
      2) 25 gauge Studs: Fasten to studs with sheet metal screws per anchor manufacturer's recommendations.
   c. Frames Set in Previously Placed Concrete or Masonry: Unless otherwise shown, anchor frames with ¼" diameter expansion bolts; space not more than 24" on center, nor with less than four (4) anchors per jamb.

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.

3. Sealant: Seal perimeter of frames and adjoining material per Section 07 92 00 – Caulking and Sealants.
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: ⅛” 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 SECTION INCLUDES

A. Materials Included: Door assemblies including frame, door, exit device, hinge, magnetic hold open, door closer, and all hardware required for a labeled assembly opening.

B. Removal of doors and hardware at existing doors and frames and replacement with new doors and/or new hardware.

1.2 RELATED SECTIONS

A. Section 06 10 00 – Rough Carpentry.

B. Section 07 92 00 – Joint Sealants.

C. Section 08 11 13 – Hollow Steel Doors and Frames.

D. Section 08 71 00 – Door Hardware.

E. Section 09 22 16 – Non-Structural Metal Framing.

F. Section 09 29 00 – Gypsum Board.

G. Section 09 91 00 – Painting.

H. Divisions 25-28 – Electrical Sections as applicable to Work of this Section.

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 [Division 01] for definitions, acronyms, and abbreviations.

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

C. Conform to the following Referenced Standards and Regulatory Requirements:


2. ADA – Americans with Disabilities Act - 2010 Standards for Accessible Design.


4. ANSI A156 Series – Builders Hardware Manufacturers Association (BHMA) Standards Set.
5. ANSI A250.4 – Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings.

6. ANSI A250.8 – Recommended Specifications for Standard Steel Doors and Frames (formerly SDI-100).

7. ANSI A250.10 – Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.

8. ASTM A526 – Specification for Sheet Steel, Zinc Coated (Galvanized) by the hot-Dip Process, Commercial Quality.


1.4 SUBMITTALS

A. General:

1. Submit in accordance with Section 01 33 00. [Division 01]

B. Pre-Hardware Schedule:

1. Report all prevailing conditions that will adversely affect satisfactory execution of work. Examine existing doors and/or frames scheduled for hardware replacement. Provide hardware necessary for completion of the work to conform with the intent of this Section as to quality, function, code compliance, and as scheduled at no additional cost to the Owner. Do not proceed with work until unsatisfactory conditions have been corrected. Starting work constitutes acceptance of existing conditions and this Contractor shall then, at his expense, be responsible for correcting all unsatisfactory and defective work encountered. Field-verify location of existing hinge reinforcing and strike plate on door frame.
C. Coordination:

1. Coordinate work of this Section with other directly affected Sections involving manufacturer of any internal reinforcement for door hardware.
   
a. In particular, coordinate door preparation in accordance with applicable regulatory and trade standards specified.
   
b. Review details and conditions prior to ordering material. If door hand is changed during construction, coordinate and change hardware as necessary at no cost to the Owner.

D. Submit a detailed door and hardware schedule according to the following:

1. Hardware Schedule:
   
a. Submit five copies of hardware schedule in vertical format as illustrated by the Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Schedules which do not comply will be returned for correction before checking. Horizontal-type schedules will be returned for correction before checking.
   
b. Hardware schedule shall clearly indicate Architect's hardware group and manufacturer of each item proposed.

2. Provide two copies of illustrations from manufacturer's catalogs and data in brochure form.

3. Wiring Diagrams: Provide complete and detailed system operation and elevation diagrams specially developed for each opening requiring electrified hardware, except openings where only magnetic hold-opens or door position switches are specified. Provide these diagrams with hardware schedule submittal for review. Provide detailed wiring diagrams with hardware delivery to jobsite.

4. Architect review of schedules does not relieve the Contractor of providing all hardware required for the Work, whether or not such hardware was inadvertently omitted from submittal. No extra cost will be allowed for changes or corrections necessary to facilitate the proper installation of hardware.

E. Single Manufacturers for Manufacturer's Devices:

1. Obtain each type of hardware from single manufacturer, although several may be indicated as offering products complying with requirements.

2. For all hardware groups/sets: one manufacturer to be provided for all exterior and interior door applications. Contractor to coordinate with Section 08 71 00.

F. Label Requirements:

1. Submit labeling information. Door label to also state the temperature rise rating of the door.

G. Templates:
1. Provide listing of manufacturer's template numbers for each item of hardware in hardware schedule.

2. Submit templates and "Reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

H. Installation Instructions:

1. Provide manufacturer's written installation and adjustment instructions for finish hardware.

2. Send installation instructions to site with hardware.

I. Contract Closeout Submittals: include specific requirements indicated below.

1. Operating and maintenance manuals: Submit three sets containing the following:
   a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Name, address, and phone number of local representative for each manufacturer.
   d. Parts list for each product.
   e. Copy of final approved hardware schedule, edited to reflect "As installed".
   f. Copy of final keying schedule.
   g. As installed "Wiring Diagrams" for each opening connected to power, both low voltage and 110 volts.

1.5 RELATED DOCUMENTS AND COORDINATION

A. This Section’s hardware sets/groups as specified in Part 3 are intended to establish type and design standard when used together with the requirements of this Section, Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections. Examine Contract Documents and furnish proper hardware for door openings. Examples include, but are not limited to, if hardware sets/groups are missing fire or smoke rated required devices, provide all devices to meet jurisdictional codes. Where hardware sets/groups have different information then the specifications, refer to the specifications and drawings for clarification and bid combined hardware sets/groups and Contract Documents/specifications. Provide all combined materials/devices at time of submittals.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable requirements of 2013 CBC regarding exiting and accessibility requirements for door and entrance hardware.
B. All hardware shall meet the requirements of 2013 CBC.

C. Provide temperature rise rating for door in Section 08 17 13. Temperature rise ratings labels shall be 250 degrees F, 450 degrees F, and 650 degrees F, and indicate the maximum rise in temperature above ambient temperature measured on the unexposed surface (non-fire side) of the door during the first 30 minutes of the standard fire test. 250 degree F temperature rise designation is the most stringent rating of the three, since it requires the most limiting rise in temperature. 250 degree F temperature rise door meets the requirements of specifications calling for a 450 degree F or 650 degree F temperature rise rating.

D. Hand-activated door opening hardware, handles, pulls, latches, locks, and other operating devices on accessible doors shall have a shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist to operate. Hardware shall be centered between 38 inches and 44 inches above finish floor/surface per 2013 CBC.

E. Panic hardware shall comply with 2013 CBC. Panic bar shall be mounted 38 inches to 44 inches above finish floor/surface. "Night Latch" (NL) hardware shall not be used for any accessible doors unless the conditions of DSA Interpretation 10-08 DSA / AC (External) revised 4/28/09 are met. Such conditions must be clearly demonstrated and indicated in the specifications. Such hardware shall have a 'dogging' feature which is dogged during the time the facility is open. Such 'dogging' operation shall be performed only by employees as their job function (non-public use). The unlatching force of panic hardware shall not exceed 15 pounds (66.72N), applied in the direction of travel.

F. Pressure to operate doors shall not exceed 5 pounds (22.2N) for exterior doors and 5 pounds (22.2N) for interior doors. When fire doors are required, the maximum effort to operate the doors shall not exceed 5 pounds (22.2 N), except that, when approved by the appropriate administrative authority, the maximum effort required to operate the doors may be increased, not to exceed 15 pounds (66.72N) per 2013 CBC. Door closers and stops shall not reduce headroom to less than 78 inches. Door closers, when provided, shall have sweep period adjusted so that from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door per 2013 CBC.

G. Floor stops shall not be located in the path of travel and 4 inches maximum from walls per DSA Policy 99-08.

H. Thresholds shall comply with 2013 CBC.

1.7 QUALITY ASSURANCE - GENERAL

A. Pre-Installation Meetings:

1. Conduct pre-installation meeting in accordance with Section 01 30 00 [Division 01].

2. Convene pre-installation meeting one week prior to commencing work of this Section.

B. Coordination.

1. Coordinate work in this Section with work in related Sections.
2. Convene coordination meeting two weeks prior to purchasing doors and
doorframes. Require attendance of the following: Architect, Contractor, Owner’s
representative, hardware supplier, door supplier, and door/frame supplier.

3. Provide hardware templates to door and frame manufacturer. Provide two
templates to those manufacturers who are not currently registered template book
holders.

4. Provide finish hardware schedule for use by the door and frame suppliers.

5. Contractor shall be responsible for verifying that the door hardware accepted for
installation is compatible for use with the doors and doorframes.

6. Coordinate keying requirements as specified in this Section.

1.8 QUALITY ASSURANCE – INTEGRATED DOOR ASSEMBLIES

A. Supplier Qualifications and Documentation:

1. Hardware Supplier Qualifications: Firm specializing in the supply and servicing of
institutional and commercial door hardware; accredited by manufacturers; and
having a minimum of three years documented experience. Hardware supplier to
furnish list of at least ten past, finished projects. Include past project contact
information including, but not limited to, date competed, project location and
references.

B. Manufacturer of Submitted Devices - Qualifications and Documentation:

1. Manufacturer Qualifications: Manufacturer specializing in manufacturing
institutional and commercial door hardware with a minimum five years with the
following documented experience. Furnish list of at least ten past, finished
projects. Include past project contact information to determine if Builders
Hardware is acceptable including, but not limited to, date competed, project
location and references.

C. Installer of Submitted Devices - Qualifications and Documentation:

1. Installer qualifications: The installer of assembly shall be trained in the trade of
hanging commercial doors on commercial frames with commercial hardware.
Supplier and Installer of door assemblies shall be authorized representative of
manufacturers and have minimum of five years successful experience in
detailing, supplying and installing integrated door assemblies specified on
projects of similar size, complexity and type to this Project.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01 60 00 [Division 01].

B. Store and protect products under provisions of Section 01 60 00 [Division 01]. Store
doors in a clean, dry area. The area must be covered and protected from the weather
and construction activities. Extreme humidity can cause product damage.
1.10 MAINTENANCE MATERIALS

A. Provide special wrenches and tools applicable to each different or special component.

B. Provide maintenance tools and accessories supplied by manufacturer.

1.11 WARRANTY

A. Provide manufacturer’s standard five-year warranty against defects in material or workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers and Products:


B. Products by the following manufacturers will be considered for approval providing all specified criteria have been met in full. Furnish all items and components of hardware required to complete the work in accordance with specifications, Contract Documents and intended operation:


C. Substitutions: Under provisions of Section 01 60 00 [Division 01].

2.2 HARDWARE TEMPLATE

A. Make templates for hardware to be applied to metal or to pre-finished doors.

B. Hinge templates shall conform to ANSI A156.7.

C. Promptly furnish template information or templates to door and frame manufacturers.

D. Coordinate hardware items to prevent interference with each other.

2.3 FIRE RATED DOORS AND EXIT DOORS

A. Provide all hardware necessary to meet the requirements of 2013 CBC for fire doors and exit doors, as well as to other requirements specified, even if such hardware is not specifically mentioned under Article “Hardware Schedule” of this Section.

2.4 DOOR AND FRAME FINISHES

A. Door Face Finish: Factory primed for field-applied paint.

B. After fabrication, thoroughly clean surfaces of mill scale, rust, oil, grease, dirt, and other foreign matter, and chemically treat with phosphate compound to assure maximum paint adhesion.
C. Apply shop coats of even consistency to provide a uniformly finished surface ready to receive finish painting.

D. Primers shall comply with ANSI A224.1, "Test Procedure and Acceptance Criteria for Primed Painted Steel Surfaces."

2.5 BHMA HARDWARE FINISHES

A. Unless otherwise specified, finishes shall be as follows:

1. BHMA 626 – satin chromium plated brass or bronze.
2. BHMA 628 – satin or dull aluminum, clear anodized (uncoated).
3. BHMA 630 – satin stainless steel.
4. BHMA 652 – satin or dull chromium plated steel.
5. BHMA 689 – sprayed aluminum paint finish.

2.6 SCREWS, BOLTS, AND FASTENING DEVICES

A. Exposed head oval phillips type screws in countersunk holes unless otherwise specified. Use screws, bolts, washers, grommets, nuts, and other fastening devices of appropriate length, type, head, metal and finish as necessary for proper match and application of hardware.

B. Threshold anchors shall be Flat Sleeve Anchors (FHSL 25 1/4 - 20 2 inch) cadmium plated expansion anchor screw in one unit.

2.7 GENERAL CONSTRUCTION AND FABRICATION

A. Exterior Doors and Frames:

1. Use galvanized steel sheets for exterior hollow metal doors, door frames and door louvers. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A569. Provide galvanized steel sheets: ASTM A924, A60 zinc coating.

B. Verify field conditions and dimensions prior to fabrication.

1. Notify Architect when field dimensions are at variance with reviewed shop drawings.
2. Corrective measures, if required, shall be determined and approved prior to fabrication.

C. Coordinate door assembly details with details of adjacent work to assure proper attachment and clean junctions. Fit and fabricate accurately with all surfaces free from warp, wave, buckle, and other defects.

D. Minimum gauges of hollow metal are specified below:

1. Unless steel stiffened, provide 18 gauge doors or heavier gauge if required by fire label requirements.
2. Provide 16 gauge frames and glazed opening frames or heavier gauge if required by fire label requirements. Entire frame and sidelight assembly shall be of same gauge.

E. Provide sheet steel conforming to ASTM A366 cold-rolled or galvanized steel. Provide sheet steel tested with ITS (Intertek / Warnock Hersey) in accordance with ASTM E-152, CAN S-104, CSFM 43.7, NFPA252, UL10B, and UL10C. Exceed all requirements of SDI 100.

F. Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18 for finishes. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

2.8 FRAMES

A. Fabricate from 16-gauge, commercial-quality, cold-rolled, carbon steel sheet conforming to ASTM A366 and ASTM A568.

1. Provide a temporary spreader bar securely fastened to the bottom of each frame, and suitable wall anchors for each jamb.

2. Typical Reinforcing: Provide minimum hinge reinforcement 3/16 inch by 1-1/2 inch by 10 inch. Provide similar reinforcement for hardware items as required to adequately withstand stresses, minimum 12 gauge, including channel reinforcement for door closers and closer arms, door holders and similar items. Provide reinforcement and clearances for concealed in-head door closers and for mortise locks.

3. Anchorage: Provide standard and special anchorage items as required. Provide formed steel channel spreader at bottom of frames, removable without damaging frame. At masonry, provide anchors (about 2 inch by 10 inch) approximately 24 inches on center.

4. Joinings: At frames with equal width jambs and head, neatly miter on face, except locations such as transom bars and at frames with large head members. Cope and butt stops. Weld length of entire joint, including face and flat intersections. Grind smooth, at other frames, provide same mitered joint wherever possible at intersection of jamb-head or jamb-sill; at other locations butt metal neatly and full weld. If tight butt joints are utilized, joints shall be neatly caulked smooth.

5. Workmanship: Fabricate so no grind marks, hollow, or other out-of-plane areas are visible. At joints of intermediate members such as mullions and transom bars, provide tight joining, neatly accomplished without holes, burned out spots, weld build up or other defacing work. Fill to close cracks and to preserve shapes. Tightly fit loose stops, to hairline joints.

6. Clearances: Provide and be responsible for proper clearances at metal frames, including for weatherstripping, soundstripping, and smoke gasketing. Glass clearance shall be thickness of glass plus clearance each side of 1/8 inch minimum exterior and 1/16 inch minimum interior. Adjust for installation, glass thickness to allow for glazing and sealant. Where sealed double glazing is indicated, provide rebates minimum of 3/4 inch and provide 1/4 inch clearance at
glass edges. Where frames fit around concrete blocks (blocks built into frames,) obtain actual dimensions of blocks being used to establish minimum clearances.

7. Electric Through-Wire:
   a. At each location where electrified hardware requires through-wires within frame provide welded junction boxes. Basis-of-Design: MG-16 device by McKinney Manufacturing, 20 gauge galvanized sheet steel or accepted equal.

2.9 DOORS

A. General:
   1. Doors shall be 1-3/4 inches thick, unless otherwise indicated on Drawings. Fabricate to sizes shown, providing necessary clearances and bevels to permit operation without binding.
   2. Seamless Vertical Edges: Construct doors with smooth flush surfaces, without visible joints or seams on exposed faces or stile edges. Interior and exterior door edge seams shall be full height wire welded and ground smooth.
   3. Doors shall be free from warp, wave, buckle or other defect. Bevel lock edge 1/8 inch in 2 inches.
   4. At exterior locations, provide fully welded and sealed top and bottom end channels that will seal water from entering the interior of the hollow metal doors.
   5. Preparation of Hardware or Electrified Devices:
      a. Door shall be mortised, reinforced, drilled and tapped at the factory from templates for all mortise hardware listed in the Hardware Schedule.
      b. Door shall be reinforced for surface applied hardware such as closers, checks, escutcheons, and kick plates; drilling and tapping shall be done in the field by door installer. Reinforcement to be 12 gauge for locksets and latchsets, and 14 gauge for surface applied hardware, except use 3/16-inch thick plate for butt hinges. Door shall be provided with reinforcing unit as recommended by lock manufacturer.
      c. Electric Through-Wire: At each location where electrified hardware requires through-wires within the door provide UL listed through-wire, concealed channel within the door.
      d. Door Position Switches: Template door and frame for door position switches approximately 4 inches to 6 inches from latching door edge. See Security drawings for additional coordination.

B. Steel Stiffened or Honeycomb:
   1. Where auto operators or card readers are part of the opening condition or function, provide reinforced 18 gauge doors steel stiffener reinforced vertically 6 inches on center full height and width, spot welded 5 inches on center to both face sheets. Stiffeners shall be welded together at top and bottom.
2. Remaining doors shall be 18 gauge honeycomb core hollow metal doors.

C. Temperature Rise Doors:

1. Provide 450 degree F temperature rise cores at all openings/locations for doors specified for Section 08 17 13.

2. In addition to the hourly rating, the fire door label to also state the temperature rise rating of the door. Temperature rise ratings labels are to be 250 degrees F, 450 degrees F, and 650 degrees F, and indicate the maximum rise in temperature above ambient temperature measured on the unexposed surface (non-fire side) of the door during the first 30 minutes of the standard fire test.

D. Factory install latchsets, locksets, push/pulls, and inset concealed vertical rod, top rod only exit device. The door shall be hung on continuous hinges. All doors shall be reinforced with 14 gauge steel for door closer and electromagnetic holder mountings. Do not install magnetic devices or closers with sex nut bolts. Exit device and other hardware shall meet the fire-rating requirement of the door, as indicated on Drawings.

2.10 HANGING HARDWARE

A. Butt Hinges and Self-Closing Hinges:

1. Butt Hinges to be manufactured in accordance with ANSI/BHMA A156.1.

2. Self-closing hinges and pivots to be manufactured in accordance with ANSI/BHMA A156.17.

3. Acceptable Manufacturers:
   a. Hager Manufacturing.
   b. Ives Manufacturing.
   c. McKinney Products Co.
   d. Stanley Works.

4. Where Hardware Groups/Sets have different information (number of hinges and sizing), refer to the following specifications for clarification and detailed requirements.
   a. Provide “weight/strength” as specified in hardware sets/groups in Part 3 hinge nomenclature Basis-of-Design weight/strength.
   b. For doors 1-3/4 inches thick and up to 36 inches wide, provide hinge height of 4-1/2 inches.
   c. For doors 1-3/4 inches thick and 37 inches to 48 inches wide, provide hinge height of 5 inches.
   d. If hardware sets specify height (example 5 inches tall at 36 inch wide door), provide height as specified for project standards at the these locations.
e. Provide two butts for doors up to 60 inches high and one additional butt for each 30 inches of height or fraction thereof. Furnish three butts for doors up to 36 inches wide. Furnish four butts for doors over 36 inches wide.

f. Provide widths sufficient to clear trim projection when door swings 180 degrees. Confirm hinge sizing with frame details. All doors shall swing 180 degrees if opening will allow. Provide wide throw hinges where required.

g. Provide non-removable pins at exterior doors and where required by Owner for security reasons.

h. Provide ball-bearing hinges for all doors with closers.

i. Electric Hinges: Provide electrified hinges with certified UL Listed, concealed wires. Provide electric hinges with standardized wire colors to accommodate up to 12 wires (4, 6, 8 or 12 as required per to provide sufficient number of concealed wires to accommodate electric function of specified hardware). If additional wires are specified (more than needed for electrified devices), provide the wires specified.

B. Continuous Hinges:

1. Stainless Steel Continuous Hinges Cycle Testing to be in accordance with ANSI/BHMA Standard A 156.26 Grade 1.

2. Hinges shall meet abuse test (ASTM F-1450-A)

3. Stainless Steel Continuous Hinge Acceptable Manufacturers:
   
   a. Markar Manufacturing.
   
   b. McKinney Products Co.
   
   c. Hager Manufacturing.
   
   d. Ives Manufacturing.
   
   e. Select Hinges.

2.11 SECURING DEVICES (LATCHING SYSTEMS)

A. Exit Devices: ANSI A156.3, Grade 1; UL Listed.

1. Acceptable Manufacturers:

   a. Adams Rite.

2. Products by the following manufacturers will be considered for acceptance providing all specified criteria have been met in full. Furnish all items and components of hardware required to complete the work in accordance with specifications, Contract Documents and intended operation.
3. Where Hardware Groups/Sets have different information, refer to the following specifications for clarification and detailed requirements:

   a. Provide Matching End Caps (MEC) on all exit devices.
   
   b. Concealed Vertical Rod acceptable. Side latching not permitted or acceptable.
   
   c. All exit devices shall be UL listed for panic. Exit devices for labeled doors shall be UL listed as "Fire Exit Hardware".
   
   d. Provide cylinders for exit devices with locking trim and cylinder dogging. Provide cylinder dogging feature for non-rated exit devices.
   
   e. Trim: Where lever trim is specified, provide lever design to match lockset levers.
   
   f. Panic hardware shall comply with 2013 CBC. Panic bar shall be mounted above 38 inches to 44 inches above finish floor/surface. The unlatching force of panic hardware shall not exceed 15 pounds (66.72N), applied in the direction of travel. "Night Latch" (NL) hardware shall not be used for any accessible doors unless the conditions of DSA Interpretation 10-08 DSA / AC (External) revised 4/28/09 are met. Such conditions must be clearly demonstrated and indicated in the specifications: Such hardware shall have a 'dogging' feature which is dogged during the time the facility is open. Such 'dogging' operation is performed only by employees as their job function (non-public use).

B. Key Systems (Cylinders, Cores and Keys):

1. Key systems (Cylinders, Cores and Keys) shall be provided and coordinated with Section 08 71 00 “Door Hardware”.

2.12 CLOSING DEVICE

A. Surface Mounted Closers: ANSI A156.4, Grade 1; UL Listed; meets UL 10C and SFM Standard 12-7-4 for positive pressure fire test.

1. Acceptable Manufacturers:

   a. LCN Manufacturing – 4040 XP Series.

2. Furnish drop plates at narrow top rail doors and parallel-arm closers at reverse bevel doors, and at doors with full 180 degrees swing. Provide drop plates, brackets, or adapters for arms as required to suit details and install as directed by manufacturer and templates. Example: Blade/Applied Stop, Norton #2018D Soffit Plate or accepted equal, for use where a blade or applied stop does not permit installation of the standard soffit plate.

3. Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
4. Supply sufficient wall reinforcement to mount closer and to withstand door closing action. Where specified, coordinate wall details for pocket closers; wall reinforcement by other Divisions. See gypsum board specifications and details.

2.13 STOPS AND HOLDERS

A. Floor and Wall Door Stops/holders and Bumpers:

1. Acceptable Manufacturers:
   a. McKinney Products.
   c. Rockwood.
   d. Hager Manufacturing.
   e. Ives Manufacturing.

2. Coordinate with Divisions 05, 06 and/or 09 for required wall backing.

3. Allow for maximum door swing.

4. Do not install manual holders on fire-rated doors.

5. Verify plans, details, shop drawings, or actual site conditions prior to ordering materials for the following “stop” devices.
   a. Provide wall stops where ever possible as specified.

c. If above floor or wall stop device installation is not possible due to pull-side installation of closers or frames not allowing more than a 90 degree swing (example: raised barrel in “cased-type” opening or special frames), then provide Trimco device #1298, wall installed at top of door height. Indicate unsuitable or incompatible wall distances before submitting hardware schedule.

B. Magnetic Door Holders:

1. Acceptable Manufacturers:
   a. Rixson Manufacturing.
   b. ABH Manufacturing.
   c. Glynn Johnson.

2. Coordinate with Divisions 25-28 for electrical work.

3. Coordinate with Divisions 05, 06 and/or 09 for required wall backing.

4. Description of Operation: When door is placed in opened position, magnetic holder will automatically engage hold open mechanism (magnet). Door releases hold open and fully closes door by manual pulling of door or by the following, self closing functions: 1) Close on fire alarm activation. Verify voltage and coordinate integration with fire alarm system; or 2) Close due to loss of power. Coordinate integration with local power system. Wiring by Division 26.

2.14 ACCESSORIES

A. Plates (Kick/mop plate):

1. Acceptable Manufacturers:
   a. McKinney Products.
   c. Rockwood.
   d. Hager.
   e. Ives.

2. Size at single doors:
   a. Push side of door two inch less than door width. Hardware set/group nomenclature: 2” LDW.
b. Pull side and one inch less than door width. Hardware set/group nomenclature: 1" LDW.

3. At pairs of doors provide width one inch less than door width on both sides.

4. Height of 10 inches, unless otherwise indicated.

B. Smoke Seals, Intumescent Seals, Sound Seals, and/or Weatherstripping:

1. Acceptable Manufacturers:
   a. McKinney Products.
   b. Pemko Manufacturing, Inc.
   d. National Guard.

2. Cutting or notching of sound gasket for stop mounted hardware shall not be permitted.

3. No intumescent is allowed on the frame. Where CBC requirements for positive pressure must be met, doors shall include all requirements as part of the door construction per 'Category A' guidelines as published by ITS/Warnock-Hersey. Only smoke gasketing applied around the perimeter of the frame to meet the 'S' smoke rating is permissible in instances where smoke control is required.

C. Astragals, Door Bottoms and Thresholds:

1. Acceptable Manufacturers:
   a. McKinney Products.
   b. Pemko Manufacturing, Inc.
   d. National Guard.

2. All thresholds shall comply with 2013 CBC. Refer to Drawings for details.

3. Where thresholds occur at openings with floor closers provide compliant device. Example: Pemko type 13 Series or 15 Series pivot/floor closer devices shall not exceed 1/2 inch in height. Refer to Drawings for details.

2.15 POWER SUPPLIES, ELECTRIFIED HARDWARE, AND WIRES

A. Power Supplies and Relays:

1. Where Hardware Groups/Sets have different information (number of hinge wires and power supply information), refer to the following specifications for clarification and submit according to complete and intended electrified system per Contract Documents. See Architectural details and specifications as well as security drawings and specifications.
a. Coordinate use of power supplies with door and frame locations. Provide power supplies, relays, and battery backup units as part of the overall system in accordance with the manufacturer’s warranty and system requirements. UL listed for applicable use; housed in an approved enclosure; and provide both Class 1 and Class 2 outputs.

b. Output shall be filtered and regulated. Relay, timer, and logic modules shall be provided as required for interface to indicated security components, and shall be assembled, connected, and fully contained within the power supply enclosure.

c. Provide required connections to fire alarm/life safety system and for remote site activation of all electrified components and functions.

2.16 ACCESSORIES

A. Glass Glazing: As specified in Division 08 Section “Glass Glazing”. Comply with hollow metal door manufacturer’s written instructions.

B. Glazing Stops at Rated Doors: LoPro by Anemostat or Slimline by Air Louvers, Inc. Factory primed, galvanized steel; mitered corners; prepared for countersink style screws. Fire-rating shall match door fire-rating. Size as indicated on Drawings. Install glazing stop fasteners on the non-secure side of doors. Finish in custom color as selected by Architect.

C. Glazing Stops at Non-Rated Doors: LoPro by Anemostat or Slimline by Air Louvers, Inc. Aluminum shape; mitered corners; prepared for countersink style screws. Size as indicated on Drawings. Install glazing stop fasteners on the non-secure side of doors. Finish in custom color as selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Provide notification of any wall condition or building structure that would prevent the proper execution of the installation of products produced in accordance with approved shop drawings.

B. Do not fabricate any product until receipt of an approved submittal drawings.

C. Verify that power supply is available to power operated devices.

D. Beginning of installation means acceptance of existing conditions.

E. Existing doors and frames: Examine existing doors and frames scheduled for hardware replacement. Provide hardware necessary for completion of the work to conform with the intent of this Section as to quality, function, code compliance, and as scheduled at no additional cost to the Owner.

F. Door-Floor Clearances: Unless otherwise shown, provide the following door-floor clearances:

1. Labeled doors: 3/8 inch maximum over floor or threshold.
2. No threshold: 3/8 inch maximum for metal doors; 3/8 inch maximum for wood doors.


3.2 INSTALLATION

A. Set frames plumb and square, and brace until adjacent wall or finish is constructed and securely anchored.

B. Install frames in accordance with SDI-105, "Recommended Erection Instructions for Steel Frames."

C. Installed assembly shall be properly aligned with required clearances for proper operation and complying with regulatory requirements.

D. Install all devices in accordance with manufacturer's printed instructions and approved shop drawings.


2. Except for hinges, do not install hardware until painting and finishing work is completed.

3. Unless otherwise shown or required by 2013 CBC, place hardware at the following heights:

   a. Hinges: Door and frame manufacturer's standard.

   b. Latchset and Lockset Handle: 38 inches above floor. Verify manufacturer's template with door design.

   c. Panic Devices: Levers shall be 38 inches above finish floor/surface. Panic push bar at interior of door shall be 38 inches to 44 inches. Verify manufacturer's template with door design.

E. Installation and Adjusting:

1. General: Pre-drill pilot holes in wood for screws. Drill and tap for surface mounted hardware on metal.

2. Install grilles and operating equipment complete with necessary hardware, according to Shop Drawings, manufacturer's written instructions, and as specified.

3. Floor Stops: Floor stops shall be installed a maximum of 4 inches from adjacent walls.

4. Thresholds: Set in waterproof sealant and fasten anchors in pre-drilled countersunk holes 18 inch on center maximum spacing and within 3 inches of each end. Minimum three anchors per threshold.
5. Auto Door Bottom (411APKL or 420APKL as specified) shall not be adjusted until substantial completion. Door bottoms shall be raised to highest position while construction occurs so to not have rubber seal torn or damaged by debris under the door. At substantial completion, adjust door bottom to fully engage and touch the floor for proper sound dampening. Adhesive Corner Pad, ACP112BL as specified, shall be free of dirt and debris; install at substantial completion.

6. Adjust parts for smooth, uniform operation. Lubricate moving parts with manufacturer recommended lubricant. Replace units that cannot be adjusted and lubricated to operate freely and smoothly as intended for the application.

7. Adjust door closer devices to meet CBC 2013.

3.3 CLEANING AND ADJUSTING

A. Prime Coat Touch-up: Immediately after erection, items with prime coat which has been damaged shall be sanded smooth and touched up with same primer as applied at shop.

B. Remove rust before above-specified touch-up is applied.

C. Touch-up shall not be obvious.

D. Adjust for proper operation of door. Lubricate moving parts as recommended by hardware manufacturer.

3.4 HARDWARE SCHEDULE

A. Manufacturers Legend:

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC</td>
<td>McKinney</td>
</tr>
<tr>
<td>IV</td>
<td>H.B. Ives</td>
</tr>
<tr>
<td>MA</td>
<td>Markar</td>
</tr>
<tr>
<td>SC</td>
<td>Schlage</td>
</tr>
<tr>
<td>LC</td>
<td>LCN Closers</td>
</tr>
<tr>
<td>AD</td>
<td>Adams Rite</td>
</tr>
<tr>
<td>TR</td>
<td>Trimco</td>
</tr>
<tr>
<td>RX</td>
<td>Rixson</td>
</tr>
<tr>
<td>SN</td>
<td>Securitron</td>
</tr>
</tbody>
</table>

B. The “Request-to-Exit” feature as described below is a security feature that announces/tells the security system if occupant is leaving the building interior area and similar to a motion-sensor the “Request-to-Exit” switch or device does not affect egress of the doors (unless noted, all doors in hardware group/sets are free egress at all times with no special knowledge to exit).

C. Hardware Columns - Example (Legend):

<table>
<thead>
<tr>
<th>Qty</th>
<th>Device Description</th>
<th>Device # (include specification language)</th>
<th>Finish</th>
<th>Manu</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
D. The following hardware sets are intended to establish type and standard of quality when used together with the requirements of this Section (see above section and related sections including Division 01).

1. Examine Contract Documents and furnish proper hardware for door openings.
2. Refer to Door Schedule on the Drawings for Hardware Group/Set assignments for each opening.
3. Blank space below is intentional to preclude splitting a Hardware Group/Set onto two pages.

<table>
<thead>
<tr>
<th>Hardware Group/Set #101</th>
<th>Ea.</th>
<th>Description</th>
<th>Model/Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Hinge</td>
<td>2</td>
<td>HG-329</td>
<td></td>
</tr>
<tr>
<td>Integrated HM Door-Exit/Panic Device</td>
<td>2</td>
<td>D3676 x MEC x 630 push bar finish</td>
<td>AD</td>
</tr>
<tr>
<td>Closer or Pocket TBD</td>
<td>2</td>
<td>P4040XP or 4003T or 4004T (as required by size of opening) TBD</td>
<td>689 LC</td>
</tr>
<tr>
<td>Pocket Closer – Wall Backing TBD</td>
<td>2</td>
<td>Furnish &amp; install fire treated wood backboard-plate or 18 gauge steel backboard-plate (size as required)</td>
<td>689 LC</td>
</tr>
<tr>
<td>Wall Mag Holder Device</td>
<td>2</td>
<td>2400L series x armature extension</td>
<td>689 AB</td>
</tr>
<tr>
<td>Wall Mag Armature Extension</td>
<td>2</td>
<td>S20020 (or length as required for 90 or 180 degree swing parallel to adjacent wall)</td>
<td>689 AB</td>
</tr>
<tr>
<td>Kick Plate</td>
<td>2</td>
<td>8400 16&quot; x 1&quot; LDW x B4E x Adhesive</td>
<td>630 IV</td>
</tr>
<tr>
<td>Smoke Seal</td>
<td>1</td>
<td>S88D (head &amp; jambs)</td>
<td>PE</td>
</tr>
<tr>
<td>Astragal x Astragal Seal</td>
<td>1</td>
<td>Overlapping astragal (welded, ground smooth, primed/painted astragal by door manufacturer x S77 Pemko-type seal )</td>
<td>PE</td>
</tr>
</tbody>
</table>

NOTE 1: Dual egress door application - travel in both directions via dual egress door and frame application (free egress by exit device push pad at all times in both directions). Description of operation: When door is placed in opened position, Magnetic Holder will automatically engage hold open mechanism (magnet). Door releases hold open devices and fully closes door by manual pulling of door or by the following, self-closing functions: 1) Close due to fire alarm activation (verify voltage and coordinate integration with fire alarm system); or 2) Close due to loss of power (coordinate integration with local power system).

NOTE 2: Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).
## Hardware Group/Set #102

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Ea.</td>
<td>Continuous Hinge</td>
<td>HG-329</td>
</tr>
<tr>
<td>2 Ea.</td>
<td>Integrated HM Door-Exit/Panic Device</td>
<td>D3676 x MEC x 630 push bar finish</td>
</tr>
</tbody>
</table>
| 1 Ea. | Fire Rated Exit/Panic Device Passage Lever or Flush Passage ADA pull | D3081E-96 x 626 FINISH  
- Verify wall has enough room the lever behind both doors  
- At door #1620, delete lever and provide D3681 Flush Passage ADA pull and integrated panic device at both doors | AD |
| 2 Ea. | Closer or Pocket TBD | 4003T or 4004T (as required by size of opening) | 689 LC |
| 2 Ea. | Pocket Closer – Wall Backing TBD | Furnish & install fire treated wood backboard-plate or 18 gauge steel backboard-plate (size as required) |
| 2 Ea. | Wall Mag Holder Device | 2400L series x armature extension | 689 AB |
| 2 Ea. | Wall Mag Armature Extension | S20020 (or length as required for 90 or 180 degree swing parallel to adjacent wall) | 689 AB |
| 2 Ea. | Kick Plate | 8400 16" x 1" LDW x B4E x Adhesive | 630 IV |
| 1 Ea. | Smoke Seal | S88D (head & jambs) | PE |
| 2 Ea. | Astragal Seals | 29310CS |

**NOTE 1:** Same single door application, free egress by exit device push pad at all times in direction of travel. Description of operation: When door is placed in opened position, Magnetic Holder will automatically engage hold open mechanism (magnet). Door releases hold open devices and fully closes door by manual pulling of door or by the following, self-closing functions: 1) Close due to fire alarm activation (verify voltage and coordinate integration with fire alarm system); or 2) Close due to loss of power (coordinate integration with local power system).

**NOTE 2:** Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).

**NOTE 3:** Where inactive or smaller leaf is too small for the D3681 flush passage ADA pull and integrated panic device at both doors, delete D3681 and 29310CS, then provide the following in submittals:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ea.</td>
<td>Auto Flush Bolt (top latch only where possible)</td>
<td>#3810 (metal doors) x fire bolt #3850 (no bottom bolt or dust proof strike)</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Coordinator (coordinator)</td>
<td>#3094 series x filler plates x mounting brackets as required for coordinated hardware x painted to match frame</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Astragal installed on 4’0” leaf</td>
<td>355CS x S77 seal</td>
</tr>
</tbody>
</table>
Note: Wall construction to be supplied by architectural plans.

For all Adams Rite Exit Devices

Standard hinge pivot points:
When the door is open at 90 degrees for non-swing clear hinges, the distance between the hinge pivot point (corner of the frame below) and any adjacent wall should be at least 4" depending on the lock manufacturer lever style.

Swing Clear: Type hinges move the face of the door closer to a 90 degrees adjacent wall by roughly 1-1/2" (depending on swing clear manufacturer & type), so the distance between the corner of the frame and any adjacent wall should be at least 5.5" depending on the lock manufacturer lever style.

Levers typically require 4" minimum between the door and an adjacent wall when combined with wall stop, floor stop or magnetic hold open devices that affect the spacing.
### Hardware Group/Set #103

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Model</th>
<th>Finish</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Continuous Hinge</td>
<td>FM-300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Integrated HM Door-Exit/Panic Device</td>
<td>D3676 x MEC x 630 push bar finish</td>
<td>AD</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pocket Closer</td>
<td>4003T or 4004T (as required by size of opening)</td>
<td>689</td>
<td>LC</td>
</tr>
<tr>
<td>2</td>
<td>Pocket Closer – Wall Backing</td>
<td>Furnish &amp; install fire treated wood backboard-plate or 18 gauge steel backboard-plate (size as required)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Wall Mag Holder Device</td>
<td>2400L series x armature extension</td>
<td>689</td>
<td>AB</td>
</tr>
<tr>
<td>2</td>
<td>Wall Mag Armature Extension</td>
<td>S20020 (or length as required for 90 or 180 degree swing parallel to adjacent wall)</td>
<td>689</td>
<td>AB</td>
</tr>
<tr>
<td>2</td>
<td>Kick Plate</td>
<td>8400 16&quot; x 1&quot; LDW x B4E x Adhesive</td>
<td>630</td>
<td>IV</td>
</tr>
<tr>
<td>1</td>
<td>Smoke Seal</td>
<td>S88D (head &amp; jambs)</td>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Astragal x Astragal Seal</td>
<td>Overlapping astragal (welded, ground smooth, primed/painted astragal by door manufacturer x S77 Pemko-type seal)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE 1:** Dual egress door application - travel in both directions via dual egress door and frame application (free egress by exit device push pad at all times in both directions). Description of operation: When door is placed in opened position, Magnetic Holder will automatically engage hold open mechanism (magnet). Door releases hold open devices and fully closes door by manual pulling of door or by the following, self-closing functions: 1) Close due to fire alarm activation (verify voltage and coordinate integration with fire alarm system); or 2) Close due to loss of power (coordinate integration with local power system).

**NOTE 2:** Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).
# Hardware Group/Set #104

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ea.</td>
<td>Electrified Hinge Transfer (Doors 48&quot; wide)</td>
<td>T4A3386 x 6 wire (size per 08 7100)</td>
<td>630 MC</td>
</tr>
<tr>
<td>2 Ea.</td>
<td>If doors are less than 48&quot; wide:</td>
<td>Delete above T4A3386 hinges, furnish and install Bommer or equal stainless steel swing clear hinge (#LB8026-R-J-5&quot; Tall or -#LB8026-V-J-5&quot; Tall as required by bevel x quantity per specifications) and Adams Rite electrified power transfer (D4612-3 or SC for swing clear applications)</td>
<td></td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Integrated Hollow Metal Door &amp; Exit/Panic Device</td>
<td>D3676 x MEC x 630 push bar finish</td>
<td>AD</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Electrified Fire Rated Exit/Panic Device Fail-Safe Lever (with key override)</td>
<td>D3081E-36 x 626 FINISH</td>
<td>AD</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>D3081E Power Supply</td>
<td>PS-1 x 4605/4606 T5ranformer (transformer as required)</td>
<td>AD</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>6-pin Schlage E/F keyway I/C Cylinders (Rim or Mortise)</td>
<td>20-057 or 20-061 x appropriate cam x blocking rings as required (C/F keyway rim or mortise type &amp; quantity as required by locking device)</td>
<td>626 SC</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Permanent Core</td>
<td>20-740</td>
<td>626 SC</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Surface Closer</td>
<td>P4040XP</td>
<td>689 LC</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Kick Plate</td>
<td>8400 10&quot; X 2&quot; LDW x B4E x CS</td>
<td>630 IV</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Door Stop</td>
<td>1270CV (wall stop preferred) or #1214 floor stop where wall stops cannot meet and touch lever hardware</td>
<td>626 TR</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Seal</td>
<td>S88D seals (head &amp; jambs)</td>
<td>PE</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Auto Door Bottom</td>
<td>420APKL</td>
<td>PE</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Threshold</td>
<td>276A (sized to fit the condition) x FHSL25</td>
<td>PE</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Door Position Switch (also known as Alarm Contact , Door Contact or DPS devices)</td>
<td>Prep/Template door and frame only if DPS devices are specified by security (coordinate door &amp; frame preparation/templates for DPS devices ordered &amp; installed by divisions 25-28 &amp; applicable drawings)</td>
<td></td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Request to Exit Device (see free egress note in above specifications)</td>
<td>Specified in above locking hardware (coordinate with divisions 25-28 and applicable drawings).</td>
<td></td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Card Reader Device(s) and Access Control (including but not limited to wire and connectivity from ceiling through frame to electrified hinge or EPT then length of wire inside the door)</td>
<td>By security or electrical as required per Contract Documents (coordinate with divisions 25-28 and applicable drawings)</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE 1:** Same Swing, single door application, free egress by exit device push pad at all times. FLS systems coordination/description of operation: during fire alarm activation or loss of building power door automatically becomes passage in function/fail safe (coordinate integration with fire alarm system and local power system).
Wiring by division 26 and 28

NOTE 2: Coordinate balance of hardware supplied by other sections including, but not limited to sections & added specification language written Section 08 71 00 “Door Hardware”. Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
<th>Model/Size</th>
<th>Finish/Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Continuous Hinge</td>
<td>HG-329</td>
<td>630 MA</td>
</tr>
<tr>
<td>1</td>
<td>Integrated Hollow Metal Door &amp; Exit/Panic Device</td>
<td>D3676 x MEC x 630 push bar finish</td>
<td>AD</td>
</tr>
<tr>
<td>1</td>
<td>Fire Rated Exit/Panic Device Keyed Lever (passage in both directions)</td>
<td>D3081-96 x 626 FINISH</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AD</td>
</tr>
<tr>
<td>1</td>
<td>Surface Closer</td>
<td>P4040XP</td>
<td>689 LC</td>
</tr>
<tr>
<td>1</td>
<td>Kick Plate</td>
<td>8400 10&quot; X 2&quot; LDW x B4E x CS</td>
<td>630 IV</td>
</tr>
<tr>
<td>1</td>
<td>Door Stop</td>
<td>1270CV</td>
<td>626 TR</td>
</tr>
<tr>
<td>1</td>
<td>Seal</td>
<td>S88D seals (head &amp; jambs)</td>
<td>PE</td>
</tr>
</tbody>
</table>

NOTE 1: Same Swing, single door application, free egress by exit device push pad at all times.

NOTE 2: Coordinate balance of hardware supplied by other sections including, but not limited to sections & added specification language written Section 08 71 00 “Door Hardware”. Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part Number</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ea.</td>
<td>Continuous Hinge</td>
<td>HG-329</td>
<td>630 MA</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Integrated Hollow Metal Door &amp; Exit/Panic Device</td>
<td>D3676 x MEC x 630 push bar finish</td>
<td>AD</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Fire Rated Exit/Panic Device Keyed Lever (passage in both directions)</td>
<td>D3081-96 x 626 FINISH</td>
<td>AD</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Fire Rated Exit/Panic Device Keyed Lever (passage in both directions)</td>
<td>Verify wall has enough room the lever behind both doors</td>
<td></td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Surface Closer</td>
<td>P4040XP</td>
<td>689 LC</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Wall Mag Holder Device</td>
<td>2400L series x armature extension</td>
<td>689 AB</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Wall Mag Armature Extension</td>
<td>S20020 (or length as required for 90 or 180 degree swing parallel to adjacent wall)</td>
<td>689 AB</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Kick Plate</td>
<td>8400 10” X 2” LDW x B4E x CS</td>
<td>630 IV</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Seal</td>
<td>S88D seals (head &amp; jambs)</td>
<td>PE</td>
</tr>
</tbody>
</table>

NOTE 1: Same Swing, single door application, free egress by exit device push pad at all times. Description of operation: When door is placed in opened position, Magnetic Holder will automatically engage hold open mechanism (magnet). Door releases hold open devices and fully closes door by manual pulling of door or by the following, self-closing functions: 1) Close due to fire alarm activation (verify voltage and coordinate integration with fire alarm system); or 2) Close due to loss of power (coordinate integration with local power system).

NOTE 2: Coordinate balance of hardware supplied by other sections including, but not limited to sections & added specification language written Section 08 71 00 “Door Hardware”. Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).
Hardware Group/Set #107 through #110 – see Section 08 71 00 “Door Hardware”

### Hardware Group/Set #111

<table>
<thead>
<tr>
<th>Item Code</th>
<th>Description</th>
<th>Part Number</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ea.</td>
<td>Continuous Hinge</td>
<td>HG-329</td>
<td>630 MA</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Integrated HM Door-Exit/Panic Device</td>
<td>D3676 x MEC x 630 push bar finish</td>
<td>AD</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Fire Rated Exit/Panic Device Passage Lever</td>
<td>D3081E-96 x 626 FINISH</td>
<td>AD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Closer</td>
<td>P4040XP</td>
<td>689 LC</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Kick Plate</td>
<td>8400 16” x 2” LDW x B4E x Adhesive</td>
<td>630 IV</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Door Stop</td>
<td>1270CV</td>
<td>626 TR</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Smoke Seal</td>
<td>S88D (head &amp; jambs)</td>
<td>PE</td>
</tr>
</tbody>
</table>

**NOTE 1:** Same single door application, free egress by exit device push pad at all times in direction of travel. Description of operation: When door is placed in opened position, Magnetic Holder will automatically engage hold open mechanism (magnet). Door releases hold open devices and fully closes door by manual pulling of door or by the following, self-closing functions: 1) Close due to fire alarm activation (verify voltage and coordinate integration with fire alarm system); or 2) Close due to loss of power (coordinate integration with local power system).

**NOTE 2:** Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).

---

END OF SECTION 08 17 13
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. Walls:
   2. Plaster: Style K, with standard cam lock.

C. Ceilings:
   1. Acoustical Tile: Style AT, with flush cam lock.
   2. Plaster: Style AP, with integral lath for plastering and flush cam lock.

D. Fire Rated Openings:
   1. General: "Fire Rated" type with flush face key operated mortise cylinder lock and interior latch release mechanism; UL rating of 1-½ hours; "B" label.
   2. Wall: Model No. 3208.

E. Fasteners: As recommended by manufacturer.

F. Primer: Rust inhibiting.
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
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Elevator door smoke containment system.

1.2 RELATED SECTIONS
   A. Division 26 – Electrical.

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, Manuals, and Codes:

1.4 SUBMITTALS
   A. General: Submit in accordance with Division 01.
   B. Product Data: Submit manufacturer’s descriptive literature and product specification.
   C. Shop Drawings: Indicate complete installation including dimensions. Show system components, related work, and interface with adjacent work and substrates.
   D. Samples: Only as requested.
   E. Quality Assurance/Control Submittals:
      1. Manufacturer qualifications.
      2. Manufacturer’s installation instructions.
F. Closeout Submittals:

1. Submit in accordance with Division 01.


3. Manufacturer’s warranty.

1.5 SYSTEM DESCRIPTION

A. Active elevator smoke containment system consisting of a tight-fitting curtain and control system deployed and activated by smoke detector. Characteristics as follows:

1. Smoke containment system deploys in less than ten seconds.

2. Fail-safe system: Loss of AC power will deploy system and automatically rewinds into housing with restoration of power. Built-in deployment delay to avoid nuisance deployment due to brief power outage, and allowing time for electric generating units to power up.

3. Approved by government authority having jurisdiction.


B. Performance Requirements:

1. Air Leakage: Not to exceed three cubic feet per minute per square foot of door opening at 0.1 inch water pressure differential at ambient temperature and 400 degrees F tested per SFM Standard 12-7-4.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer Qualifications: Firm specializing in manufacturing products specified in this Section with a minimum five years experience.

2. Installer Qualifications: Factory trained by manufacturer.

B. Pre-Installation Meetings:

1. Conduct pre-installation meeting in accordance with Division 01.

2. Convene pre-installation meeting prior to commencing work of this Section. Attendees: Owner, Architect, Contractor, smoke containment system contractor, painting contractor, electrical contractor.

3. Review substrate conditions, requirements of related work, installation instruction, storage and handling procedures, and protection measures.

4. Keep meeting minutes including responsibilities of various parties.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Comply with requirements of Division 01.

B. Deliver products in manufacturer's original containers, dry and undamaged, with seals and labels intact.

C. Storage and Protection: Store materials in a dry secure place. Protect from weather, surface contaminants, corrosion, construction traffic, and other potential damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

   Product: Smoke Guard System Model M400.

B. Substitutions: Under provisions of Division 01.

2.2 SMOKE CONTAINMENT SYSTEM

A. Components:

1. Curtain:
   a. Film: Minimum one mil thick transparent polyimide film reinforced with minimum 100 denier Nomex yarn at 0.25 inch each way.
   b. Magnetic strips: Flexible multi-pole strips attached to longitudinal edges of film with low modulus silicone adhesive.

2. Housing: 20 gauge powder coated, cold rolled steel container with dust cover and door with concealed hinges.

3. Auxiliary Rails:
   a. Material: ASTM A240/A240M, Type 430, ferretic stainless steel; 16 gauge.
   b. Size: 2 inches wide; 1 inch deep, as shown on shop drawings.

4. Rewind Motor: Manufacturer's standard; complies with California Electrical Code.

5. Release Mechanism: Manufacturer's standard; complies with UL Standard 864.

6. Screen Rewind Switch: Manufacturer’s standard; activated from both sides of screen; mounted 42 inches above finished floor.

7. Wiring, connections, and other components as required for a complete system and as standard with manufacturer.

B. Identification: Provide a label at each smoke containment system with the following information:
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine job site conditions and verify field dimensions.

B. Verify substrate, hoistway frames, electrical requirements, and related work is ready to receive work and in accordance with approved shop drawings and coordination arrangements.

C. Report unacceptable conditions to Architect. Begin installation only when unacceptable conditions have been corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer’s printed instructions and approved shop drawings.

B. Securely fasten components to wall construction. Install units plumb and free from warp or twist while maintaining dimensional tolerances and alignment with adjacent surfaces.

3.3 FIELD QUALITY CONTROL

A. Conduct field testing in accordance with manufacturer’s cycle test procedures in the presence of Owner, Architect, local Fire Marshal, fire alarm contractor, and elevator contractor. Notify attendees at least seven days in advance of scheduled testing.

B. Complete maintenance service record.

3.4 CLEANING

A. Clean as recommended by manufacturer. Do not use materials or methods which may damage finish or surrounding construction.

3.5 DEMONSTRATION

A. Demonstrate required testing and maintenance procedures to Owner’s Representative.

END OF SECTION 08 34 76
SECTION 08 71 00
FINISH HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work under this Section shall include all materials and installation necessary to provide Finish Hardware as shown and detailed on the Drawings and specified herein.

1.2 QUALITY ASSURANCE

A. References:

1. General: Satisfy applicable fire, building and accessibility codes and rules.

2. Accessibility Standards:


5. Underwriters Laboratories: UL 10B and 305.

1.3 QUALIFICATIONS:

A. Supplier:

1. General: A firm specializing in the supply and servicing of institutional and commercial door hardware for at least five (5) years.

1.4 COORDINATION:

A. The hardware groups/sets specified in section 08 71 00 - Part 3 are intended to establish type and design standard when used together with the requirements of this Section, Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections. Examine Contract Documents and furnish proper hardware for door openings. Refer to specifications for clarification and detailed requirements and provide products and services in specifications even if not written in hardware groups/sets in section 08 71 00 - Part 3.

B. Coordinate work of this Section with other directly affected Sections involving manufacturer of any internal reinforcement for door hardware. In particular, coordinate door preparation in accordance with applicable regulatory and trade standards specified.

1. Provide hardware templates to door and frame manufacturer. Provide two templates to those manufacturers who are not currently registered template book holders.

2. Provide finish hardware schedule for use by the door and frame suppliers.
3. Where hardware sets/groups have different information than the specifications, refer to the specifications and drawings for clarification and bid combined hardware sets/groups and Contract Documents/specifications. Provide combined materials/devices at time of submittals in addition to other coordination items:

   a. Coordinate keying requirements as specified in this Section.

C. Convene coordination meeting between all opening vendors and installers at least two weeks prior to purchasing doors, frames, door hardware, and electrical devices required for complete systems.

   1. Required attendance includes, but is not limited to, the following: Contractor, hardware supplier and/or installer, door supplier and/or installer, frame supplier and/or installer, security card reader vendor and/or installer, and electrical contractor.

   2. Contractor shall be responsible for verifying that the door hardware accepted for installation is compatible for use with the doors and door-frames.

   3. For card reader interface with applicable door devices, security vendor and/or installer (coordinate accordingly) shall have a written agenda and plan on how scope related to electrified devices will be installed to have a complete wired and operational card access system. The card reader interface scope includes, but is not limited to, card reader input and output coordination on the electric locking device power supply, electric locking devices and connectivity, and confirmation of a complete, wired, and operational card access system. Provide all required relays and devices as part of the overall system in accordance system requirements at no additional cost.

1.5 SUBMITTALS

A. Hardware Schedule:

   1. General: Submit completely detailed finish hardware schedule via electronic PDF in vertical format as illustrated by the Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Reference headings to hardware groups specified and clearly indicate door type, or mark, describe its location, hand, size, door and frame material, and fire rating, if applicable. Organize all doors with the exact same hardware group under one heading, either per building, or per project. If per project, list doors per building in numerical order. Horizontal-type schedules will be returned for correction before checking

   2. Wiring Information: Provide manufacturers' wiring information including manufacturers' door elevation diagrams for electrified hardware based on Door Hardware Institute (DHI) core class “Electrified Architectural Hardware” DHI class #COR133. Openings where only magnetic hold-opens or door position switches are specified do not require wiring information. Provide information with hardware schedule submittal for review. Provide detailed wiring diagrams with hardware delivery to jobsite.

   3. Non-Acceptance: Coded or keyed hardware scheduling, creating a separate heading for every door and requiring reference to master lists of products is not acceptable, and will be rejected without review.

B. Manufacturers List:

   1. General: List manufacturer's names and product numbers for items used in
hardware schedule to facilitate checking for compliance.

2. **Product Source:** Furnish each type of lock and latchset from a single manufacturer, unless more than one manufacturer's products are specified.

3. **Substitutions:** Refer to Section 01 60 00 – Product Requirements. If substitutions are offered, list both the specified product and the proposed substitution.

   a. **Samples:**
      
      1) General: Submit, with hardware schedule, physical sample of each item proposed to be substituted for specified item.
      
      2) Label: Clearly mark each sample to indicate name of item, brand name, manufacturer's catalog number and item for which it is proposed to be substituted.
      
      3) Disposition: Approved samples may be used in work; rejected samples will be returned.

1.6 **PRODUCT HANDLING**

A. **General:** Refer to Section 01 31 00 – Coordination.

B. **Packaging:** Mark all materials so as to identify door number, hardware type, location and hand of door.

C. **Keys:** Label and deliver all keys to University's Representative.

D. **Coordination:**

   1. General: Hardware applied to aluminum or metal doors and frames and factory prepared wood doors and frames shall be made to template; provide two copies of approved finish hardware schedule for use by door and frame suppliers.

   2. Distribution: Furnish two copies of each template to those manufacturers who are not listed as current registered template book holders; furnish two copies of each template for items whose manufacturers do not provide registered template book.

1.7 **MAINTENANCE**

A. **Guarantee:**

   1. General: Provide in required form for a period of one (1) year from date of final acceptance by University.

   2. Door Closers: Twenty-five (25) years.

   3. Exit Devices: Five (5) years.

**PART 2 - PRODUCTS**

2.1 **MATERIALS**

A. **SPECIFIED PRODUCTS AND ACCEPTABLE MANUFACTURERS**
Catalog numbers used below are those of the following specified manufacturers. Acceptable alternate manufacturers are as listed; items produced by acceptable manufacturers, comparable to those specified in material, weight, size, function, design and finish will be considered accepted equals to those items specified and will not require submittal of physical sample or request for substitution. Any other manufacturers other than those listed as "Specified" or "Acceptable Manufacturer" will be considered as "or equal" subject to requirements for substitution requests or required by Division 01. University's Representative’s decision regarding any item submitted for approval as equal to that specified shall be final.

<table>
<thead>
<tr>
<th>Product</th>
<th>Specified</th>
<th>Acceptable Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges:</td>
<td>McKinney</td>
<td>Hager, Stanley, PBB</td>
</tr>
<tr>
<td>Interior Doors:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Locks and Cylinders:</td>
<td>Schlage</td>
<td>No known equal</td>
</tr>
<tr>
<td>Exterior Doors:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Locks and Cylinders:</td>
<td>Primus</td>
<td>No known equal</td>
</tr>
<tr>
<td>Closers:</td>
<td>LCN 4040</td>
<td>Dorma, Yale</td>
</tr>
<tr>
<td>Floor/Wall Stops:</td>
<td>Quality/Trimco</td>
<td>Glynn Johnson</td>
</tr>
<tr>
<td>Exit Devices:</td>
<td>Von Duprin</td>
<td>Precision American Device</td>
</tr>
<tr>
<td>Thresholds and Weatherstrip:</td>
<td>Pemko</td>
<td>National Guard; Zero</td>
</tr>
<tr>
<td>Silencers:</td>
<td>Brass</td>
<td>Quality, Signature</td>
</tr>
<tr>
<td>Trim:</td>
<td>Ives/Trimco</td>
<td>Door Controls Int’1; Quality, Signature Brass</td>
</tr>
<tr>
<td>Special Items:</td>
<td>Door Controls Intl.</td>
<td>H.B.Ives; Telkee; Lund; Key Control Systems, Inc.</td>
</tr>
</tbody>
</table>

B. Manufactured Units:

1. Locks:
   a. General: Provide wrought boxes for strikes.
   b. Keys: Furnish three (3) uncut blanks for each lockset, in keyways to match project system.

2. Closers: Key valve type or screw type; furnish one key for each five (5) closers. Fasten with four (4) sex bolts per closer. Provide 180° opening where indicated. Provide parallel arms with jamb attachment for all out-swinging doors. Supply drop plates at narrow top rail doors, as required.

3. Screws, Bolts, and Fastening Devices: Exposed head oval Phillips type in countersunk holes, unless otherwise specified or required. Use screws, bolts, washers, grommets, nuts, and other fastening devices of appropriate length, type, head, metal and finish, as necessary for proper match and application of hardware. See Section 05 50 00 – Miscellaneous Metal Fabrications.
4. Fire Rated Doors: Equip fire rated doors with UL listed hardware meeting requirements of CBC Chapter 7-43 and Fire Protection Equipment list of Underwriters Laboratories, Inc.

5. Padlock: Schlage PL4741 padlock or equal keyed as directed for roof hatches, gates, traffic barrier bollards and roof access ladder security covers.

6. Thresholds: Provide all thresholds, door bottoms and seals as specified, or detailed. Provide thresholds with non-standard custom-drilled screw holes where details indicate this requirement.

7. Butt Hinges:
   a. General Locking reverse bevel doors shall be furnished with NRP feature butts. All doors with closers shall be furnished with ball, or oilite bearing butts.
   b. Exterior: Butts for reverse bevel exterior doors shall be of equivalent model listed, but shall be of nonferrous metal.
   c. Size: Unless otherwise specified, the size of the butts will be determined by the following rules:
      1) Doors 1-⅜" thick and up to 2'-4" wide: 3-½" butts.
      2) Doors 1-⅜" inch thick over 2'-4" to 3'-0" Wide: 4" butts.
      3) Doors 1-⅜" thick up to 3'-0" wide: 4-½" butts.
      4) Doors 1-⅜" thick over 3'-0" wide: 5" butts.
      5) Note: All butts shall be of proper width to clear trim in projection to allow 180° swing and that width shall be determined by the following rules:
      6) For doors up to 2-¼" thick: twice the door thickness, plus trim projection, less ½", equals the proper hinge width. For doors 2-¼" to 3" thick: twice the door thickness, plus trim projection, less ¾" equals the proper hinge width. Furnish three butts for each door leaf up to 7'-0" high. Furnish an additional butt for each 2'-0" of door height over 7'-0".

2.2 KEYING

A. General: All keyed locks shall have temporary cylinders or plugs during construction. Provide following:

1. Grand Master Key System:
   a. General: Key to University's existing Primus Controlled Access Grand Master Key System; provide six (6) cut GMK and six (6) cut Master Keys per set; allow for four (4) Master Key sets.
   b. Keying: All final keying to be performed by UCDMC Lock Shop. Deliver interior and exterior cylinders to University's Representative for final re-
keying.

2. Key Control System: Visual; stamp keys with key set symbols.

3. Change Keys: Three (3) standard bow change keys per cylinder.

2.3 FINISHES

A. General: Provide finishes as follows, unless otherwise indicated:

<table>
<thead>
<tr>
<th>Item</th>
<th>Exterior/Interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges:</td>
<td>630 (32D)</td>
</tr>
<tr>
<td>Interior Hinges:</td>
<td>652 (26D)</td>
</tr>
<tr>
<td>Locks:</td>
<td>626 (26D)</td>
</tr>
<tr>
<td>Closers:</td>
<td>689 (Aluminum finish)</td>
</tr>
<tr>
<td>Floor Closers:</td>
<td>626 (26D)</td>
</tr>
<tr>
<td>Stops:</td>
<td>626 (26D)</td>
</tr>
<tr>
<td>Exit Devices:</td>
<td>626 (26D)</td>
</tr>
<tr>
<td>Thresholds/Weatherstripping:</td>
<td>628 (28)</td>
</tr>
<tr>
<td>Trim:</td>
<td>626 (26D)</td>
</tr>
<tr>
<td>Protection Plates:</td>
<td>63G (32D)</td>
</tr>
<tr>
<td>Special Items:</td>
<td>As Noted</td>
</tr>
<tr>
<td>Key Cabinet:</td>
<td>Manufacturer’s standard</td>
</tr>
</tbody>
</table>

B. Provide keyed, construction cores and keys during the construction period:

1. Provide Schlage large format, interchangeable black or gold brass construction cores and brass keys at all doors (interior and exterior):

2. Plastic cores are not permitted.

3. Furnish construction keys in the following quantities:
   - 20 each = Construction masterkeys.
   - 3 each = Construction Core Extractor keys.

4. Construction control and operating keys and core shall not be part of the University Representative’s permanent keying system or furnished in the same keyway (or key section) as the University Representative’s permanent keying system.

C. Under the Contractor bidding/pricing:

1. Key Systems (Cylinders, Cores and Keys.):
   - Schlage Lock manufacturing – large format, interchangeable, E or F keyway cores.
   - Building standard, no substitutions permitted.

2. Contact the University Representative’s including locksmith to develop the keying matrix (i.e. how to key the project openings/doors), who will cut keys & pin cores/cylinders provided via the purchased lock manufacturer (Contractor PROVIDE ALL PARTS AND DEVICES and keying services) and to install at all keyed openings/doors:
3. Perform keying meeting, programming schedule and the following tasks: After hardware has been submitted and reviewed in accordance with Division 01 requirements and 08 71 00, arrange a keying matrix/programming meeting with University Representative and 08 7100 Vendor representing the Schlage lock and key system.

   a. Provide copies of the reviewed door and frame submittals (brought to the meeting) with card reader and keyed doors highlighted on plans for review session.

   b. Follow procedures for keying meeting & Programming Schedule as outlined by the Door Hardware Institute (DHI procedures are based on example Door Hardware Institute core class entitled Masterkeying class #AHC200)

   c. Keying meeting to produce a programming schedule/matrix based on the following:

   d. Furnish meeting notes and three (3) compete, typed copies of keying and programming schedule to University Representative for final review.

   e. Permanent keys and cores to be stamped with the applicable key mark for identification. The visual key control marks or codes shall not include the actual key cuts.

4. Contractor to install permanent cores in presence of University Representative.

D. Fire Control Key Boxes:

1. Product: Rapid Entry System.

2. Provide Knox Box(s) at the main entrance(s) for all new buildings on the UC Davis Campus. University’s Representative to coordinate locations to be determined by the UC Davis Fire Department. For Knox Box procedures, refer to UCDMC Fire Department Standards. Recommended location is 4 to 5 feet above ground and no more than 2 feet from the door.

PART 3 - EXECUTION

3.1 APPLICATION

A. General: Install in strict conformance with referenced standards, the manufacturer's written directions, as shown, and as herein specified.

B. Floor Clearances: Unless detailed otherwise on Drawings, provide following clearances:

   1. Labeled Doors: ¾” maximum over floor or threshold.

   2. No Threshold: ¾” maximum for metal doors; ⅝” maximum for wood doors.

   3. Threshold: ¼” typical.

   4. Carpet: ¼” over top of nap, unless otherwise shown.
C. Hardware Placement: Except for hinges, do not install hardware until completion of painting and finishing work. Unless detailed otherwise, place hardware at following height above finish floor:

1. Strike (Centerline) for Locks and Latches: Between 40" and 42".
2. Hinges: Manufacturer’s standard.
3. Door Pull (Centerline): 42".
4. Push Plate (Centerline): 44".
5. Deadlocks (Centerline of Cylinder): 44".

D. Installation:

1. General: Install hardware in precise manner; door clearance and hardware placement as specified. Predrill pilot holes in wood for screws. Drill and tap for surface mounted hardware on metal.
2. Hinges: Set hinge leaves snug and flat in mortises; turn screws to flat seat (do not drive). Drive hinge pins down and tighten setscrews.
3. Closers: Mount door closers for maximum swing of door before setting stops.
4. Silencers: Set in place before adjusting strikes.
5. Locksets: Install locks with keyways in proper position, and levers, roses and escutcheons firmly affixed.
6. Thresholds: Set in waterproof sealant and secure with lead shields and countersunk screws of same finish as threshold. In heavy traffic areas use Hilti Countersunk Kwik Bolt II, size dependant on height of threshold, or equal.

E. Reinstallation Of Existing Doors:

1. Examine existing openings (frames and/or doors) scheduled for hardware replacement or refurbishment: Where hardware groups/sets have different information, refer to the following for clarification. Provide hardware groups/sets devices along with added devices as indicated on drawings and detailed requirements for each type of device

   a. Existing openings in this contact to be determined by Contract Documents including but not limited to requirements in the above specification language, architectural plans, door schedule pages, door details pages and/or full specification documents.

   b. Frame may have bent out of "plumb, square and true", shim and adjust doors to swing per manufacturer’s recommendations.

   c. Provide hardware necessary for completion of the work to conform with the intent of this Section as to quality, function, code compliance, and as scheduled at no additional cost to the Owner.

   d. Uninstall hardware at existing doors and do not re-install old hardware or
install new hardware until painting and finishing work is completed.

e. Where either #1) new doors are to be installed at existing frames or #2) existing doors and frame are to remain, the new mounting heights for locksets may not align with the existing hardware preparations/templating.

1) Prepare openings to accept the new hardware (including new hinges, strikes and strike location, and/or additional hardware specified below and in and above specifications:

a) Verify in field existing hanging/hinge requirements for installation (see specifications and manufacturer’s printed instructions).

(1) Where continuous hinges are installed in place of butt-type hinges, fill abandoned hinge openings/preps in the existing frames, then fill with bondo, grind/sand smooth surface smooth and prime/paint per Section 09 91 00.

(2) Furnish and install correct sized shims and filler plates: sized to either Don Jo device # HF-45 or SHF-45 or size as required for each opening.

b) Verify in field existing closers requirements for installation (see specifications and manufacturer’s printed instructions).

c) Verify in field existing locking device requirements for installation (see specifications and manufacturer’s printed instructions).

(1) Verify in field existing strikes. Provide and install new ANSI 4-7/8 inch or standard 2-3/4 inch strikes to match existing frame preparation/template unless “Unit-type” locks and latches were previously installed.

(2) Where “Unit-type” locks and latches where previously installed, as part of Contract, provide labor and material to retrofit “Unit-type” lock and latchset strikes to become either ANSI 4-7/8 inch strikes for mortise devices or standard 2-3/4 inch strikes for cylindrical devices.

(3) At exit/panic device locations, provide new strikes as required for hardware latching systems.

2) Fill abandoned hinge strike openings/preparations in the existing openings with like-gauge materials.

a) At non-rated openings fill abandoned strike, hinges and or old screw or installation holes in the existing door
and/or frames. Fill with bondo, grind/sand smooth surface smooth, and prime/paint per Section 09 91 00.

b) At rated openings fill abandoned strike, hinges and or old screw or installation holes in the existing door and/or frames only in accordance with CBC 2013 (abandoned preps with like-gauge materials). Prime/paint per Section 09 91 00.

2. After cutting and installation (through Intertek or approved agency). Contact Information: Intertek Northern California Recertification Representative: Lawrence Ruiz Cell phone (925) 698 -0437 // Email: lawrence.ruizatintertek.com (Intertek ETL SEMKO main phone number: 608-836-4400)

3.2 ADJUSTMENT AND MAINTENANCE

A. General: Prior to acceptance, adjust all moveable parts to assure smooth operation.

B. Door Closers: Adjust for closing speed, latching speed, back checking, and adjust hold-open devices for full control of door. Maximum effort to operate doors shall not exceed 5.0 lbs. for exterior doors, 5.0 lbs. for interior doors, and 15 lbs. for fire doors.

3.3 CLEANING

A. General: Upon completion, thoroughly clean all exposed surfaces per manufacturer’s instructions.

3.4 SCHEDULES

A. Manufacturers Legend:

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>H.B. Ives</td>
</tr>
<tr>
<td>MC</td>
<td>McKinney</td>
</tr>
<tr>
<td>HA</td>
<td>Hager</td>
</tr>
<tr>
<td>SC</td>
<td>Schlage</td>
</tr>
<tr>
<td>LC</td>
<td>LCN Closers</td>
</tr>
<tr>
<td>VO</td>
<td>Von Duprin</td>
</tr>
<tr>
<td>PE</td>
<td>Pemko</td>
</tr>
<tr>
<td>TR</td>
<td>Trimco</td>
</tr>
<tr>
<td>RX</td>
<td>Rixson</td>
</tr>
<tr>
<td>SN</td>
<td>Securitron</td>
</tr>
</tbody>
</table>

B. The “Request-to-Exit” feature as described below is a security feature that announces/tells the security system if occupant is leaving the building interior area and similar to a motion-sensor the “Request-to-Exit” switch or device does not affect egress of the doors (unless noted, all doors in hardware group/sets are free egress at all times with no special knowledge to exit).

C. Hardware Columns - Example (Legend):

<table>
<thead>
<tr>
<th>Qty</th>
<th>Device Description</th>
<th>Device # (include specification language)</th>
<th>Finish</th>
<th>Manu</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D. The following hardware sets are intended to establish type and standard of quality when
used together with the requirements of this Section (see above section and related sections including Division 01).

1. Examine Contract Documents and furnish proper hardware for door openings.

2. Refer to Door Schedule on the Drawings for Hardware Group/Set assignments for each opening.

3. Blank space below is intentional to preclude splitting a Hardware Group/Set onto two pages.

Hardware Group/Set #101

| 1 | Ea. | 6-pin Schlage E/F keyway I/C Cylinders (Rim or Mortise) | 20-057 or 20-061 x appropriate cam x blocking rings as required (C/F keyway rim or mortise type & quantity as required by locking device) | 626 | SC |

NOTE 1: Hardware supplied by section 08 17 13 “Integrated Door Assemblies”.

NOTE 2: Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).

Hardware Group/Set #102

| 1 | Ea. | Permanent Core | 23-030 (coordinate with University Representative) | 626 | SC |

NOTE 1: Balance of hardware supplied by section 08 17 13 “Integrated Door Assemblies”. Coordinate with section 08 17 13 doors for required keying.

NOTE 2: Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).

Hardware Group/Set #103

| 1 | Ea. | 6-pin Schlage E/F keyway I/C Cylinders (Rim or Mortise) | 20-057 or 20-061 x appropriate cam x blocking rings as required (C/F keyway rim or mortise type & quantity as required by locking device) | 626 | SC |

NOTE 1: Hardware supplied by section 08 17 13 “Integrated Door Assemblies”.

NOTE 2: Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).

Hardware Group/Set #104

| 1 | Ea. | Permanent Core | 23-030 (coordinate with University Representative) | 626 | SC |

NOTE 1: Balance of hardware supplied by section 08 17 13 “Integrated Door Assemblies”. Coordinate with section 08 17 13 doors for required keying.

NOTE 2: Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).
### Hardware Group/Set #105

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6-pin Schlage E/F keyway I/C Cylinders (Rim or Mortise)</td>
<td>105 Ea.</td>
<td>626 SC</td>
</tr>
<tr>
<td></td>
<td>20-057 or 20-061 x appropriate cam x blocking rings as required (C/F keyway rim or mortise type &amp; quantity as required by locking device)</td>
<td>626 SC</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Permanent Core</td>
<td>1 Ea.</td>
<td>626 SC</td>
</tr>
<tr>
<td></td>
<td>23-030 (coordinate with University Representative)</td>
<td>626 SC</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE 1:** Balance of hardware supplied by section 08 17 13 “Integrated Door Assemblies”. Coordinate with section 08 17 13 doors for required keying.

**NOTE 2:** Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).

### Hardware Group/Set #106

**NOTE 1:** Hardware supplied by section 08 17 13 “Integrated Door Assemblies”.

**NOTE 2:** Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).

### Hardware Group/Set #107

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Swing Clear Hinges</td>
<td>105 Ea.</td>
<td>630 BO</td>
</tr>
<tr>
<td></td>
<td>Swing clear hinge (#LB8026-R-J-5” Tall or -#LB8026-V-J-5” Tall as required by bevel x quantity per specifications)</td>
<td>630 BO</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Low Profile Exit/Panic Device Keyed Lever (with key override)</td>
<td>105 Ea.</td>
<td>626 VO</td>
</tr>
<tr>
<td></td>
<td>9575-L- F x LP373L</td>
<td>626 VO</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>6-pin Schlage E/F keyway I/C Cylinders (Rim or Mortise)</td>
<td>105 Ea.</td>
<td>626 SC</td>
</tr>
<tr>
<td></td>
<td>20-057 or 20-061 x appropriate cam x blocking rings as required (C/F keyway rim or mortise type &amp; quantity as required by locking device)</td>
<td>626 SC</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Permanent Core</td>
<td>1 Ea.</td>
<td>626 SC</td>
</tr>
<tr>
<td></td>
<td>20-740</td>
<td>626 SC</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Surface Closer</td>
<td>1 Ea.</td>
<td>689 LC</td>
</tr>
<tr>
<td></td>
<td>P4040XP</td>
<td>689 LC</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Kick Plate</td>
<td>1 Ea.</td>
<td>630 IV</td>
</tr>
<tr>
<td></td>
<td>8400 10” X 2” LDW x B4E x CS</td>
<td>630 IV</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Door Stop</td>
<td>1 Ea.</td>
<td>630 TR</td>
</tr>
<tr>
<td></td>
<td>1209</td>
<td>630 TR</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Seal</td>
<td>1 Ea.</td>
<td>PE</td>
</tr>
<tr>
<td></td>
<td>S88D seals (head &amp; jambs)</td>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Door Sweep</td>
<td>1 Ea.</td>
<td>PE</td>
</tr>
<tr>
<td></td>
<td>315CN</td>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Threshold</td>
<td>1 Ea.</td>
<td>PE</td>
</tr>
<tr>
<td></td>
<td>2727A or 176A or per detail (sized to fit the condition) x FHSL25</td>
<td>PE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Overhead Rain Drip</td>
<td>1 Ea.</td>
<td>PE</td>
</tr>
<tr>
<td></td>
<td>346C X FFW</td>
<td>PE</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE 1:** Same Swing, singe door application, free egress by exit device push pad at all times.

**NOTE 2:** Coordinate balance of hardware supplied by other sections including, but not limited to sections & added specification language written Section 08 71 00 “Door Hardware”. Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents). At non-rated doors, delete Von Duprin –F nomenclature.
### Hardware Group/Set #108

<table>
<thead>
<tr>
<th></th>
<th>Ea.</th>
<th>Description</th>
<th>Model/Details</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hinge</td>
<td>T4A3786 (size &amp; quantity per 08 7100)</td>
<td>652</td>
<td>MC</td>
</tr>
<tr>
<td>1</td>
<td>Storeroom-Type Lockset</td>
<td>L9080T x 17A</td>
<td>630</td>
<td>SC</td>
</tr>
<tr>
<td>1</td>
<td>6-pin Schlage E/F keyway I/C Cylinders (Rim or Mortise)</td>
<td>20-057 or 20-061 x appropriate cam x blocking rings as required (C/F keyway rim or mortise type &amp; quantity as required by locking device)</td>
<td>626</td>
<td>SC</td>
</tr>
<tr>
<td>1</td>
<td>Permanent Core</td>
<td>23-030 (coordinate with University Representative)</td>
<td>626</td>
<td>SC</td>
</tr>
<tr>
<td>1</td>
<td>Surface Closer</td>
<td>4040XP EDA (installed push-side of door if door swings out into corridor) or 4040XP x REG (installed pull-side of door if door swings in) per section 08 71 00 specification</td>
<td>689</td>
<td>LC</td>
</tr>
<tr>
<td>1</td>
<td>Kick Plate</td>
<td>8400 10” X 2” LDW x B4E x CS</td>
<td>630</td>
<td>IV</td>
</tr>
<tr>
<td>1</td>
<td>Door Stop</td>
<td>1270CV</td>
<td>626</td>
<td>TR</td>
</tr>
<tr>
<td>1</td>
<td>Seal</td>
<td>If frame is aluminum, then seals are to be furnished by aluminum frame mfg (rated seals are to be furnished by rated aluminum frame mfg). If frame is hollow metal, furnish S88D seals (head &amp; jambs) by Pemko or approved seal manufacturer.</td>
<td>PE</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).

### Hardware Group/Set #109

<table>
<thead>
<tr>
<th></th>
<th>Ea.</th>
<th>Description</th>
<th>Model/Details</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hinge</td>
<td>T4A3786 (size &amp; quantity per 08 7100)</td>
<td>652</td>
<td>MC</td>
</tr>
<tr>
<td>1</td>
<td>Privacy x Occupancy Indicator (exterior side lever can be left unlocked. Emergency cylinder/key override)</td>
<td>L9496T x 17A x L583-363</td>
<td>630</td>
<td>SC</td>
</tr>
<tr>
<td>1</td>
<td>6-pin Schlage E/F keyway I/C Cylinders (Rim or Mortise)</td>
<td>20-057 or 20-061 x appropriate cam x blocking rings as required (C/F keyway rim or mortise type &amp; quantity as required by locking device)</td>
<td>626</td>
<td>SC</td>
</tr>
<tr>
<td>1</td>
<td>Permanent Core</td>
<td>23-030 (coordinate with University Representative)</td>
<td>626</td>
<td>SC</td>
</tr>
<tr>
<td>1</td>
<td>Surface Closer</td>
<td>4040XP EDA (installed push-side of door if door swings out into corridor) or 4040XP x REG (installed pull-side of door if door swings in) per section 08 71 00 specification</td>
<td>689</td>
<td>LC</td>
</tr>
<tr>
<td>1</td>
<td>Kick Plate</td>
<td>8400 10” X 2” LDW x B4E x CS</td>
<td>630</td>
<td>IV</td>
</tr>
<tr>
<td>1</td>
<td>Mop Plate at Inswinging doors</td>
<td>8400 6” X 1” LDW x B4E x CS</td>
<td>630</td>
<td>IV</td>
</tr>
<tr>
<td>1</td>
<td>Door Stop</td>
<td>1270CV (wall stops where possible, but provide #1214 if wall stop cannot be utilized at lever side of door)</td>
<td>626</td>
<td>TR</td>
</tr>
<tr>
<td>1</td>
<td>Seal</td>
<td>If frame is aluminum, then seals are to be furnished by aluminum frame mfg (rated seals are to be furnished by rated aluminum frame mfg). If frame is hollow metal, furnish S88D seals (head &amp; jambs) by Pemko or approved seal manufacturer.</td>
<td>PE</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).
### Hardware Group/Set #110

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ea.</td>
<td>Hinge</td>
<td>T4A3786 (size &amp; quantity per 08 7100)</td>
<td>652 MC</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Office-Type Lockset</td>
<td>L9453 x #17A lever x L583-363 ADA Thumbturn</td>
<td>630 SC</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>6-pin Schlage E/F keyway I/C Cylinders (Rim or Mortise)</td>
<td>20-057 or 20-061 x appropriate cam x blocking rings as required (C/F keyway rim or mortise type &amp; quantity as required by locking device)</td>
<td>626 SC</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Permanent Core</td>
<td>23-030 (coordinate with University Representative)</td>
<td>626 SC</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Surface Closer</td>
<td>4040XP EDA (installed push-side of door if door swings out into corridor) or 4040XP x REG (installed pull-side of door if door swings in) per section 08 71 00 specification</td>
<td>689 LC</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Kick Plate</td>
<td>8400 10” X 2” LDW x B4E x CS</td>
<td>630 IV</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Door Stop</td>
<td>1270CV</td>
<td>626 TR</td>
</tr>
<tr>
<td>1 Ea.</td>
<td>Seal</td>
<td>If frame is aluminum, then seals are to be furnished by aluminum frame mfg (rated seals are to be furnished by rated aluminum frame mfg). If frame is hollow metal, furnish S88D seals (head &amp; jambs) by Pemko or approved seal manufacturer.</td>
<td>PE</td>
</tr>
</tbody>
</table>

**NOTE:** Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).

### Hardware Group/Set #111

**NOTE 1:** Hardware supplied by section 08 17 13 “Integrated Door Assemblies”.

**NOTE 2:** Furnish all devices & components for hardware groups/set above in accordance with Contract Documents (including but not limited to additional hardware devices requirements in the above specification language, architectural plans & full specification documents).

**END OF SECTION 08 71 00**
PART 1 - GENERAL

1.1 DESCRIPTION
A. Scope: Work under this Section shall include all materials and installation necessary to provide Glass and Glazing as shown and detailed on the Drawings and specified herein.

1.2 QUALITY ASSURANCE
A. References:
   1. American National Standards Institute (ANSI):
   2. Flat Glass Marketing Association (FGMA): Glazing and Sealant Manuals.

1.3 SUBMITTALS
A. Shop Drawings: Submit list of materials proposed for use; identify each glazing condition.
B. Samples: Manufacturer’s standard color range.
C. Product Data: None required for specified products; required for alternate products.

1.4 PRODUCT HANDLING
A. Delivery: Deliver with manufacturer’s labels intact; do not remove until completion of final inspection.

1.5 SITE CONDITIONS
A. Environmental Requirements: Glaze in dry conditions; minimum temperature 40°F during and 48 hours after installation of glazing compounds.
B. Protection: Protect glass from damage until occupancy of building; replace glass damaged or broken before final acceptance.

1.6 MAINTENANCE
A. Guarantee:
   1. General: Provide in required form for stated period from date of final acceptance
PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacture:

1. PPG Industries, Inc. Glass Group, unless otherwise indicated, Southwall Technologies, or equal.

2. Tempered Glass and Safety Glazing: Comply with United States Consumer Product Safety Commission's "Safety Standards for Owner's Architectural Glazing Materials" (16 CFR part 1201) category I or II, as applicable; UBC Standard 54-2 and Section 5406 (c) of CBC.

B. Flat Glass:

1. General: Size and thickness as shown.

2. Float Glass: ASTM C1036, Type 1 transparent flat, Class 1 clear, quality q3 glazing select.

3. Tempered Glass: ASTM C1048, fully tempered with horizontal tempering.

4. Low E Glass: "Sungate 100" clear [gray] [bronze] [Solagreen] [Azurlite] [Solex]; thickness as shown, or equal, no known equal.

5. Insulated Glass Units: ASTM E774 and E773; double pane with glass elastomer edge seal; outer pane \(\frac{7}{32}\)" clear glass, inner pane of \(\frac{3}{16}\)" clear glass; inter pane space purged by dry air; total unit thickness of \(\frac{29}{32}\)". IGCC class CBA rating.

C. Glazing Materials:

1. General: Factory mixed materials recommended by glass manufacturer for each glazing condition. Provide glazing and bedding putties to match color of frame, sealants, tapes, and other materials necessary to perform glazing work. Provide setting blocks, shims, compression seals, felt and neoprene or vinyl glazing channels as required.

2. Butyl Glazing Tape:

   a. General: 1202T as manufactured by 3M Construction Markets, the Pecora Corp., or equal.

D. Accessories:

1. General: Materials recommended by glass or glazing material manufacturer.

2. Setting Blocks and Spacers: Neoprene chemically compatible with specified

4. Filler Rod: Compressible synthetic rubber or foam.

5. Primer-Sealers and Cleaners: As recommended by glass manufacturer.

2.2 Glazing Types

A. GL-1: Low-E Insulating Glass:

1. Acceptable Manufacturers:
   a. PPG Industries.
   b. Oldcastle Glass.
   c. Viracan.
   d. PPG Industries.
   e. Guardian.
   f. Substitutions: Under provisions of Division 01.

2. Material: 1 inch thick hermetically sealed assembly consisting of 1/4 inch thick Low-E clear glass on the outboard surface (coating on the #2 surface), 1/2 inch air space and 1/4 inch thick clear glass on the inboard surface with a Summer Daytime U-value of 0.30 or less, Solar Heat Gain Coefficient (SHGC) of 0.29 or less, and Visible Light Transmittance of 55 percent. Glass shall be heat strengthened; tempered where required by CBC and where indicated on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean contact surfaces with solvent and wipe dry. Seal porous glazing channels or recesses with material compatible with sealer. Prime surfaces scheduled to receive sealant.

3.2 INSTALLATION

A. General: Install in conformance with referenced standards, manufacturer's written directions, as shown, and as specified.

B. Glass:

1. Dimensions: As shown; tolerances as recommended by manufacturer.

2. Edges: Per referenced standards; nipped edges, or edges treated with abrasives are not acceptable.
C. Glazing:

1. General: Use glass as shown; glue with glazing compound or glazing gaskets as required.

2. Tempered Glass:
   a. General: Type and thickness, as shown.

3. Insulated Glass Units:
   a. General: Install on exterior, where shown.
   b. Low-E Glass: Install coated surface on inside of insulated glazed units.

D. Wood Stops: Do not glaze openings in wood doors or openings with wood stops until rebates and stops have been prime-coated as specified in Division 9, Section 09 90 00 – Painting.

3.3 CLEANING

A. General: Upon completion, thoroughly clean glass and frames of labels, smears, spots and other markings or defacement. Do not use alkaline or abrasive agents to clean glass.

END OF SECTION 08 81 00
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Continuous wall louvers.

1.2 RELATED WORK

A. Section 05 40 00 – Cold-Formed Metal Framing.
B. Section 07 25 00 – Weather Barriers.
C. Section 07 60 00 – Flashing and Sheet Metal.
D. Section 07 92 00 – Caulking and Sealants.
E. Section 09 91 00 – Painting.

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. Standards, manuals, and codes refer to the latest edition of such standards, manuals, and codes in effect as of the date of issue of this Project Manual, unless indicated otherwise in CBC Chapter 35 and CFC Chapter 80.

C. Referenced Standards:
   1. AMCA 500-L – Laboratory Methods of Testing Louvers for Rating.
   2. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

1.4 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacture of AMCA certified louvers with sufficient documented experience.

B. Louvers shall bear Air Movement and Control Association (AMCA) Certified Ratings Seals for air performance and water penetration ratings.

1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division 01.
B. Indicate on shop drawings layout, elevations, dimensions and tolerances; head, jamb, and sill details, blade configuration, screening, and frames.
C. Submit manufacturer's installation instructions under provisions of Division 01.

D. Samples: Submit two 6 inch by 6 inch samples of selected finish color on specified metal substrate.

1.6 COORDINATION

A. Coordinate work of this Section with installation of framing, flashings, interior and exterior wall finishes and mechanical systems.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS AND MANUFACTURERS – WALL LOUVERS


D. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Steel Sheet: ASTM A653, G90 galvanized.

2.3 COMPONENTS

A. Louver Blades:
   1. Slope: 30 degrees.
   2. Blade Type: Fixed.

B. Frame:
   1. Shape: Channel.
   2. Head, jamb and sill material thickness: 16 gauge steel.

C. Intermediate concealed vertical mullions: Same material and gauge as louver.

D. Fasteners and Anchors: Stainless steel or type as recommended by manufacturer.

2.4 ACCESSORIES

A. Flashings: Of same material as louver frame. Refer to Section 07 60 00.
A. Insect Screen and Frame: Galvanized steel frame with 18 x 14 galvanized insect mesh, fabricated by louver manufacturer. Install on interior side of louver.

B. Flexible Flashing Materials: As specified in Section 07 25 00.

C. Sealants: As specified in Section 07 92 00.

D. Neoprene isolation pads for installation between dissimilar metals.

2.5 FABRICATION

A. Louver Size: 4 inches deep, face measurements as indicated, but not to exceed 40 square feet per panel. Nominal free area opening percentage of 51 percent, with storm-proof blades.

B. Head and Sill Members: Roll formed to required shape, one piece per location.

C. Vertical mullions: At louver panels greater than 48 inches wide, provide intermediate concealed vertical mullions for support of louver blades at interior side of panels.

1. Spacing: Centered on width of louver.

D. All welded construction.

E. Screens: Screw to louver frame.

2.6 FINISHES

A. Provide factory finished louvers. Finish louvers after assembly.

1. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers’ written instructions. Custom color as selected by Architect.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on shop drawings.

B. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

A. Install louver assembly in accordance with manufacturer’s instructions.

B. Install louvers level and plumb.

C. Secure louvers in opening framing with concealed fasteners.
D. Louver frame shall be anchored to structure with concealed fasteners appropriate for use with type of adjacent construction. Fasteners shall securely fasten louver frame to wall construction involved. Fasteners shall provide stiffness and rigidity to keep frames square, in accurate position without twisting, buckling or warping. Fasteners to framing substrate shall be the following minimums; greater as required by the louver manufacturer or as conditions warrant:

1. Metal Framing: #14 stainless steel self-tapping sheet metal screws at 12 inches on center all around by length as required to penetrate framing member 1/4 inch minimum.

E. Install perimeter flexible flashing membrane around all window openings in accordance with manufacturers' installation instructions and under provisions of Section 07 25 00.

F. Install metal flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

G. Install insect screen on the interior face of the louver frame with mechanical fasteners.

H. Install perimeter sealant to method required to achieve performance criteria and installation criteria described in Section 07 92 00.

3.3 CLEANING

A. Clean surfaces and components per manufacturer’s recommendations.

END OF SECTION 08 91 19
DIVISION 09
FINISHES
SECTION 09 21 16.23
GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1   GENERAL

1.1  SECTION INCLUDES

A. Gypsum board shaft wall assemblies for the following:

   1. Shaft-wall enclosures.

1.2  RELATED SECTIONS

A. Section 07 21 00  – Building Insulation.

B. Section 07 84 00  – Firestopping.

C. Section 07 92 00  – Caulking and Sealants.

D. Section 09 22 16  – Metal Stud System.

E. Section 09 29 00  – Gypsum Board.

F. Section 09 91 00  – Painting.

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:


   2. ASTM A653/A653M  – Standard Specification for Steel Sheet, Zinc-Coated
(Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the
Hot-Dip Process.

   3. ASTM C475  – Standard Specification for Joint Compound and Joint Tape for
Finishing Gypsum Board.

   4. ASTM C954  – Standard Specification for Steel Drill Screws for the Application
of Gypsum Panel Products or Metal Plaster Bases to Steel Studs
from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.

   5. ASTM C1047  – Standard Specification for Accessories for Gypsum Wallboard
and Gypsum Veneer Base.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23.

B. Product Data: Provide product data and material safety data sheets on gypsum board, joint tape, topping compound, texture and all accessories.

C. Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

A. Applicator: Firm specializing in work of this Section.

B. Fire-Resistance Ratings: Provide fire-resistance ratings as indicated on Drawings. Materials and construction shall be identical to assemblies with fire-resistance ratings determined according to ASTM E119 by a testing and inspecting agency.

C. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures for installing gypsum board shaft-wall assemblies including, but not limited to, the following:

1. Fasteners proposed for anchoring nonstructural steel framing to building structure.

2. Sprayed fire-resistive materials applied to structural steel framing.

3. Wiring devices in shaft-wall assemblies.

4. Doors and other items penetrating shaft-wall assemblies.

5. Items supported by shaft-wall-assembly framing.

6. Mechanical work enclosed within shaft-wall assemblies.

1.6 REGULATORY REQUIREMENTS

A. Install in strict accordance with all published applicable regulations by local, state or federal agencies that may have jurisdiction.
1.7 DELIVERY, STORAGE AND HANDLING

A. Steel framing and related accessories shall be stored and handled in accordance with the A.I.S.I. “Code of Standard Practice.”

B. All materials shall be stored in a safe, dry area in the original factory supplied packaging clearly marked with type of material and UL or other labels as required. It is the responsibility of Contractor to ensure that all materials are properly stored at the jobsite and remain free of damage and defects.

1.8 JOB AND ENVIRONMENTAL CONDITIONS

A. Warm environment is ideal; avoid installation in subfreezing or wet conditions.

B. Protect applicators and occupants from nuisance dust when saw-cutting.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:


B. Substitutions: Under provisions of Section 01 60 00.

2.2 PANEL PRODUCTS

A. Gypsum Board: ASTM C1396/C1396M; 5/8-inch thick, Type X, maximum permissible length; ends square cut, tapered edges.

B. Gypsum Shaftliner Board: ASTM C1396/C1396M; 1-inch thick, Type X, maximum permissible length, 24 inches wide, double beveled edges.

1. Basis-of-Design Product: Sheetrock Brand Gypsum Liner Panels by United States Gypsum Company; or accepted equal.

2.3 METAL FRAMING

A. Conform to the requirements of Section 09 22 16 for conditions indicated on Drawings.

B. Metal Studs: Steel C-H Studs, J and E-Studs.

C. Metal Runners: J-Runners.

2.4 ACCESSORIES

A. Accessories: As recommended by the gypsum board manufacturer to meet required fire ratings.
B. Corner Bead, U Bead (Edge Trim), Metal Trim and Control Joints: GA 216; ASTM C1047; sheet steel, zinc coated by hot-dipped process in accordance with ASTM A653/A653M, minimum G40 coating.

C. Joint Materials: ASTM C475, GA 216; reinforcing tape, joint compound, adhesive, water and fasteners.

D. Fasteners: Screws, Type S, conforming to ASTM C954, self-drilling and self-tapping steel screws with double-lead thread design as approved by system manufacturer for standard and heavier gauge load bearing steel framing.

E. Acoustical Insulation: Refer to Section 07 21 00.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that site conditions are ready to receive work and meet the design criteria for an approved installation.

B. Ensure all materials are free of defects and are labeled by an approved listing and labeling service.

C. Do not proceed with installation until deficiencies are corrected and surfaces are acceptable.

D. Beginning of installation means acceptance of existing conditions.

3.2 SHAFT WALL INSTALLATION

A. Comply with GA 600 and with shaft wall system manufacturer’s installation instructions and details.

1. Fire-Resistance Ratings: As indicated on Drawings.

B. Studs and Liner Panels:

1. Position steel runners at floor and ceiling with the short leg toward finish side of wall. Securely attach runners to structural support with power driven fasteners at both ends and maximum 24 inches on centers. With steel frame construction, install floor and ceiling runners and J or E-Studs before installing gypsum liner panels (Two-hour steel fireproofing). For other structural steel fireproofing requirements, use Z-shaped stand-off clips secured to structural steel before fireproofing application.

2. Cut liner panels 1 inch less than floor-to-ceiling height and erect vertically between J-Runners. Where shaft walls exceed maximum available panel height, position liner panel end joints within upper and lower third points of wall. Stagger joints top and bottom in adjacent panels. Screw studs to runners on walls over 16 feet in height.

3. Use steel C-H Studs 3/8 inch to not more than 1/2 inch less than floor-to-ceiling height, and install between liner panels with liner inserted in the groove. Install full-length steel J or E-
studs vertically at T-intersections, corners, door jambs, and columns. Install full-length E-Studs over gypsum liner panels both sides of closure panels. For openings, frame with vertical J or E-Stud edges, horizontal J-Runner at head and sill, and reinforcing as shown on Drawings. Suitably frame all openings to maintain structural support for wall.

4. Install floor-to-ceiling steel E-Studs each side of steel hinged door frames and jamb struts each side of elevator door frames to act as strut-studs. Attach strut-stud to floor and ceiling runners with two 3/8 inch Type S-12 pan head screws. Attach strut-studs to jamb anchors with 1/2 inch Type S-12 screws. Over steel doors, install a cut-to-length section of J-Runner and attach to strut-studs with 3/8 inch Type S-12 screws.

C. Gypsum Panels (Single layer one side, one hour fire-rating): Apply 5/8 inch Type X gypsum board panels, on corridor side. Position gypsum panel vertically and fasten to studs and runners with 1 inch Type S Screws 12 inches on centers.

D. Gypsum Panel Joints: Comply with applicable requirements of Section 09 29 00. Finish all face layer joints and internal angles with a Joint System installed according to manufacturer’s recommendations. Spot exposed fasteners on face layers and finish corner bead, control joints and trim as required, with at least three coats of joint compound, feathered out onto panel faces and sanded smooth.

E. Corner Bead: Reinforce all vertical and horizontal exterior corners with corner bead fastened with clinch-on tool or staples 9 inches on centers on both flanges along entire length of bead.

F. Metal Trim: Where shaft wall terminates against masonry or other dissimilar material, apply metal trim over face layer edge and fasten with screws or staples spaced 9 inches on centers.

G. Control Joints: Break panels behind joint. Apply acoustical sealant to fill gap and attach control joint to face layer with staples spaced 6 inches on centers on both flanges along entire length of joint.

H. Screws: Power-drive at least 3/8 inch from edges or ends of gypsum panels to provide uniform dimple 1/32 inch deep. In gypsum base, set flush with surface without tearing face paper.

I. Do not bridge architectural or building expansion joints with shaft-wall assemblies; frame both sides of expansion joints with furring and other support.

J. At fire rated walls with more than a 16 foot vertical span, do not fasten shaft wall top track directly to support above. In these conditions, provide slip track or slip clips for attachment of shaft wall top track to supporting structure, with appropriate firestopping products.

K. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items. Refer to Section 07 84 00 for firestopping products and requirements.

L. Acoustical Insulation: Install acoustical insulation per Section 07 21 00.

3.3 TOLERANCES

A. Maximum Variation from True Flatness: 1/4 inch in 10 feet in any direction.

3.4 CLEANING AND PROTECTION
A. Cleaning and Repair: Clean surfaces that have been spotted or soiled during wallboard application.

B. Defective Work: Remove and replace defective work that cannot be satisfactorily repaired, at the direction of Architect, at no cost to Owner.

   1. Remove and replace panels that are wet, moisture damaged, or mold damaged.

C. Protection: Protect installed work against damage from other construction work.

D. Upon completion of the work under this Section, remove all surplus material, rubbish and debris from the premises and leave floors "broom clean".

END OF SECTION 09 21 16.23
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 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) \#3064P.

   2. Metal Studs: ASTM C645, non-load bearing type with punched webs; roll-formed electro-galvanized steel sheet in the following gages:

      16ga 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: 2-3/4” x 3/4” deep with 1/2” wide flanges.
   b) Zee: 1-1/2” x 1-1/2”.

2. Floor runners or C-Track: 16ga Un-punched track (for OSHPD projects).

3. Top Runner or Slotted Track: 16ga deep leg punched track (for OSHPD projects).

4. Stud Stiffeners: 3/4” 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; ¼” x ½”, 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 ¾” 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 intermediately; 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.

D. Suspended Gypsum Board Ceilings and Soffits: Refer to Section 09 22 26.23 – Metal Suspension Systems.

3.3 CLEANING

A. See Section 01 74 00 – CLEANING.
SECTION 09 22 26.23
METAL SUSPENSION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Suspended gypsum board ceiling metal framing system.

1.2 RELATED SECTIONS
A. Section 03 30 00 – Cast-in-Place Concrete.
B. Section 05 31 00 – Steel Decking.
C. Section 09 29 00 – Gypsum Board.
D. Divisions 21 - 23 – Mechanical.
E. Divisions 25 - 28 – Electrical.

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:
   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. General: Submit in accordance with Division 01.
B. Product Data: Submit manufacturer’s descriptive literature and product specification for each product.

C. Shop Drawings:
   1. Indicate typical layout including dimensions.
   2. Submit drawings showing field measured dimensions.
   3. Submit detail drawings of special accessory components not included in manufacturer’s product data.

1.5 SYSTEM DESCRIPTION

A. Metal framing system for single layer suspended gypsum board ceiling.

B. Alternative systems conforming to CBC Table 2508.1 may be proposed. Conform to substitution requirements per Division 01. Include in proposal specifications and shop drawings showing framing layout, member sizes, hanger locations, fastening, and attachment details.

C. Alternative suspended gypsum board ceiling framing systems may be submitted with appropriate current ICC-ES Report. Install in accordance with manufacturer’s instructions and ICC-ES Report. Conform to substitution requirements per Division 01.

D. Substitutions are subject to OSHPD approval.

1.6 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer Qualifications: Firm specializing in manufacturing products specified in this Section with a minimum five years experience.
   2. Installer Qualifications: Firm specializing in installing work specified in this Section with experience on at least five projects of similar nature in past three years.

B. Coordinate work in this Section with work in related Sections.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Division 01.

B. Deliver products in manufacturer's original containers, dry and undamaged, with seals and labels intact.

C. Storage and Protection:
   1. Store materials in a dry secure place. Protect from weather, surface contaminants, corrosion, construction traffic, and other potential damage.
   2. If materials are stored outdoors, stack materials off ground, supported on a level platform, and fully protected from the weather.
D. Handling: Handle materials carefully to prevent damage. Remove damaged materials and provide new items.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Galvanized or galvannealed steel conforming to ASTM A653/A653M, minimum G40 or Z120.

B. Grade:
   1. 16 gauge and heavier, \( F_y = 50 \text{ ksi} \)
   2. 18 gauge and lighter, \( F_y = 33 \text{ ksi} \) minimum.

2.2 COMPONENTS

   1. Main Runners: Cold-rolled steel channels; 1-1/2 inch by 16 gauge; 0.475 pounds per foot, minimum.
   2. Cross-Furring: Cold-rolled steel hat channels: 7/8 inch by 22 gauge.

B. Wire Hangers: ASTM A641/A641M, zinc-coated wire, Class 1, soft temper, pre-stretched.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine job site conditions and verify field dimensions. Verify hangers will not interfere with other work.

3.2 INSTALLATION

A. Install ceiling metal suspension system in accordance with, CBC Section 2508.1, approved shop drawings, and as specified in this Section.

B. Install ceiling metal suspension system after major above ceiling work is complete. Coordinate location of hangers with other work.

C. Hang suspension system independent of walls, columns, ducts, pipes and conduits.

D. Install cross furring as recommended by gypsum board manufacturer to prevent sagging at maximum 24 inches on center, and 16 inches on center for 5/8 inch moisture resistant gypsum board per CBC Section 2509.3.3, saddle tied to main runners using one strand of No. 16 gauge or two strands of No. 18 gauge tie wire.

E. Use No. 8 gauge hanger wires saddle tied to main runners as follows:
   1. 3 feet-0 inches on center maximum, where main runners are spaced 4 feet-
2. 3 feet-6 inches on center maximum, where main runners are spaced 3 feet-6 inches on center.

3. 4 feet-0 inches on center maximum, where main runners are spaced 3 feet-0 inches on center.

F. Splice main runners and cross-furring per CG2.31 and CG2.32 of OPD-0003-13.

G. Fasten hanger wires with not less than three tight turns. Fasten bracing wires with four tight turns. Make all tight turns with a distance of 1-1/2 inch. Hanger or bracing wire anchors to the structure should be installed in such a manner that the direction of the wire aligns as closely as possible with the direction of the forces acting on the wire.

H. Separate all ceiling hanging and bracing wires at least 6 inches from all unbraced ducts, pipes, conduit, etc. It is acceptable to attach lightweight items, such as single electrical conduit not exceeding 3/4 inch nominal diameter, to hanger wires using connectors acceptable to Architect and OSHPD.

I. When drilled-in concrete anchors or shot-in anchors are used in reinforced concrete for hanger wires, one out of ten wire-anchor assemblies shall be tested for 200 pounds tension. When drilled-in concrete anchors are used for bracing wires, one out of two wire-anchor assemblies shall be field tested for 440 pounds tension. Shot-in anchors in concrete are not permitted for bracing wires. Refer to CBC Section 1913A.7.1 if any shot-in or drilled-in anchor fails.

J. Provide trapeze or other supplementary support members at obstructions to typical hanger spacing. Provide additional hangers, struts or braces as required at all ceiling breaks, soffits, or discontinuous areas. Where hanger wires are more than one in six out of plumb, provide counter-sloping wires.

3.3 BRACING ASSEMBLIES

A. Provide bracing assemblies consisting of a compression strut and four 12 gauge splayed bracing wires oriented 90 degrees from each other. Splayed bracing wires shall be taut and shall not exceed 45 degrees from the ceiling plane. Splices in bracing wires are not permitted. Space bracing assemblies as follows:

1. Not more than 8 feet by 12 feet on center.

2. Not more than 1/2 of the spacing given above from the perimeter wall and at the edge of vertical ceiling offsets.

B. Ceiling grid members shall be attached to two adjacent walls. Main runners and furring channels shall be at least one inch clear of other wall and furring shall be at least 3/4 inch clear of other wall. Where walls run diagonal to the ceiling grid system runners, one end of main runner and furring shall be free with standard clearances.

C. The width of the perimeter supporting closure angle shall be not less than two inches. The use of angles with smaller widths in conjunction with perimeter clips will require an alternate method of compliance with adequate justification.
D. Suspended ceiling systems with a ceiling area of 144 square feet or less, and fire rated ceiling systems with an area of 96 square feet or less, surrounded by walls which connect directly to the structure above, do not require bracing assemblies when attached to two adjacent walls.

3.4 SUPPORT AND ANCHORAGE OF LIGHT FIXTURES AND MECHANICAL SERVICES

A. Support drop-in light fixtures and ceiling mounted mechanical air terminals and services directly by main runners or by supplemental framing which is supported by main runners and positively attached with screws or other approved connectors.

B. Attach surface mounted fixtures to main runners with a positive clamping device made of minimum 14 gauge material. Rotational spring clamps do not comply.

3.5 TOLERANCES

A. Maximum Variation from True Plane: 1/4 inch in 10 feet in any direction.

END OF SECTION 09 22 26.23
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 40ºF.

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-Coat 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 ⅛” 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 ⅛” 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. 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; 5/8" 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. Gypsum Sheathing: Conform with ASTM C1177 or C1278; "Type X", or equal; 2'-0" x 8'-0" x %", fire rated with UL label.

G. Fasteners:
   1. Fasteners to Wood Members:
      a. Manufactured by the U.S. Steel Corp.
      b. Commercial Steel and Supply Co., or equal.
      c. Screws: Type W drywall screws.

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. 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 ¾” 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.

D. Gypsum Sheathing:

1. Install gypsum sheathing in accordance with GA-253 and manufacturer’s instructions.

2. End joints, if required should be offset; joints should fit snugly and flashing installed around all openings.

3. Install maximum lengths possible to minimize number of joints. Edge joints must be located parallel to and with vertical orientation on framing. End joints of adjacent lengths of sheathing must be staggered.

4. Attach gypsum sheathing to frame with screws. Drive fasteners so as to bear tight against and flush with surface of sheathing. Do not countersink fasteners. Fasteners must be located at least 3/8 inches from edges and ends of sheathing panels.

5. Do not leave exposed surfaces of gypsum sheathing unprotected beyond the manufacturer’s recommendation without a weather barrier cladding.

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
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”.

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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 50ºF (10ºC) 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. ASTM D2047: Coefficient of friction 0.5 or greater.

4. 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.

5. 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: As specified on the Drawings.
C. Wall Tile: As specified on the Drawings.

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. Setting Materials: Provide materials to comply with referenced standards; as required for installation method designated.

F. Grouting Materials: Provide Commercial Portland Cement Grout; complying with ANSI A118.6; of color selected by Architect.

G. 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.

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”.

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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 (commercial portland cement) 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.

### 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
SECTION 09 51 13
ACOUSTICAL TILE CEILINGS

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. "School Zone Fine Fissured #1713"; square edge, paint finish, in color selected by University’s Representative from white to off-white; minimum NRC of 0.70; minimum light reflectance of 0.85; ASTM E1264 flame spread rating of 25 and smoke developed rating of 50.

   a. Size: 24 inches x 24 inches x 3/4 inch.

C. Acoustical Tile:

1. "Fine Fissured #746"; square edge, paint finish; minimum NRC of 0.55; minimum light reflectance of 0.85; Class I; ASTM E1264 flame spread rating of 25 and smoke developed rating of 50.

   a. Size: 12 inches x 12 inches x 5/8 inch.
2. Adhesive: As recommended by acoustical tile manufacturer.

D. 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: EMT shall be ANSI C80.3 / UL 797 carbon steel with G90 galvanizing. EMT shall have a minimum yield strength of 30 ksi and minimum ultimate strength of 48 ksi.
   a. "Donn Compression Post" manufactured by the USG Interiors, Inc.
   b. Armstrong World Industries, Inc. or equal

E. Acoustical Sealant: As recommended by acoustical material manufacturer, for application shown.

F. 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 3/8" 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 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. Acoustical Tile:

1. Tile: Install smooth, level or plumb, as shown; with exposed tile joints true and straight, and junctures neat, tight and properly trimmed. Unevenness, edge or corner offsets, cupping, scratches, broken tile or other imperfections, not acceptable.

2. Adhesive: Place 1-¼" diameter, minimum, spots of adhesive at corners. Press and slide tile into place with face surface aligned and level.

E. 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.

F. Light Fixtures:
1. All fixtures must be positively attached to the suspension system. The attachment device must be able to withstand 100% of the weight of the fixture acting in any direction.

2. Fixtures weighing 56 lbs. or less must have two 12-gage wires attached at diagonal corners. These wires may be slack.

3. Fixtures weighing more than 56 lbs. must be independently supported from the building structure.

G. Mechanical Services:

1. Mechanical services less than or equal to 10 lbs. must be positively attached to the suspension system main beams or cross tees.

2. Terminals or services weighing greater than 10 lbs. but less than or equal to 56 lbs. must have two 12-gage wires connecting them to the ceiling system hangers or to the structure above.

3. Terminals or services weighing more than 56 lbs. must be independently supported.

H. 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: ½” in 10'0”.


3.4 CLEANING

A. General: Upon completion, thoroughly clean exposed surfaces per manufacturer's instructions.

END OF SECTION 09 51 13
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, resilient stair accessories, and resilient flooring accessories, 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 50° and 90°F.
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.

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.

B. Rubber Stair Treads and Risers: Products of style suitable for use indicated and complying with FS RR-T-650, Composition A.

C. Landings: Products of same manufacturer and material as stair treads.

2.4 INSTALLATION ACCESSORIES
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. 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 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 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 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.

1. Before cleaning, strip protective floor polish that was applied to vinyl products on floors and stairs after completing installation only if required to restore polish finish and if recommended by resilient product manufacturer.

2. After cleaning, reapply polish on vinyl products on floors and stairs to restore protective floor finish according to resilient product manufacturer’s written recommendations. Coordinate with University's maintenance program.

3.5 RESILIENT FLOORING ACCESSORY SCHEDULE

A. Rubber Wall Base:

1. Product: Burke Cove Wall Base, as manufactured by Burke Flooring, or equal.

2. Color and Pattern: As selected by Architect.


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.

B. Rubber Stair Treads and Accessories:

1. Product: Norament® stairtread, one-piece nosing, tread, and riser as manufactured by Nora Rubber Flooring.

2. Rubber Stair Treads and Risers:
   a. ASTM F2169, Type TS (rubber, vulcanized thermoset), PVC-free, asbestos-free; rubber content approximately 46 percent.
   b. Type: Class 2, raised round pattern, 0.16 inch (4.0 mm) overall thickness, 0.02 inch (0.5 mm) raised pattern thickness.
   d. Sizes: Custom lengths as required, full width of tread/riser.
   e. Depth: 12 inches, unless otherwise indicated on Drawings.
f. Abrasion Resistance: ASTM D3389, H-18 wheel, 500 gram load, 1000 cycles, weight loss not greater than 0.4 gram.

g. Slip Resistance: ASTM D2047, 0.8 or greater.

h. Hardness: ASTM D2240, Shore A, not less than 75.

i. Static Load Limit: 800 psi, 0.005 inch or less residual compression per ASTM F970.

j. Fire-Test-Response Classification:

   1) Smoke Developed: 450 or less, ASTM E662.

   2) Critical Radiant Flux: Class 1, ASTM E648 (NFPA 253).

k. Color: As selected by Architect.

l. Wear Warranty: Ten years.

m. Environmental Requirements: Product to meet GreenGuard indoor air quality certification requirements.

n. Adhesive: Solvent-free, non-flammable, high strength, as recommended by stair tread/riser manufacturer for substrates indicated.

o. Provide 2-inch contrasting color strips complying with CBC requirements for the visually impaired. Contrasting color as selected by Architect.

3. Landing Material: Rubber sheet flooring to match stair tread material in all respects.

END OF SECTION 09 65 13
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.
2. Rubber Sheet Flooring.

B. Related Sections include the following:

1. Section 07 26 50 – VAPOR CONTROL MEMBRANE.
2. 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 1.

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. 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. 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.

D. 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 consistent with existing floor tile. Do not quarter turn tiles.

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 as selected by Architect
3. Class: Class 2 - through pattern
4. Thickness: ¼” (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
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 12 00 - Structural Steel Framing; for shop priming structural steel.
2. Section 05 50 00 – Miscellaneous Metal Fabrications; for shop priming ferrous metal.
3. Section 05 51 00 – Metal Stairs.
4. Section 07 60 00 – Flashing and Sheet Metal.
5. Section 08 11 00 – Hollow Metal Doors and Frames.
6. Section 08 31 00 – Access Doors.
7. Section 09 21 16.23 – Gypsum Board Shaft Wall Assemblies.
8. Section 09 29 00 – Gypsum Board.

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 15 when measured at an 85º meter.
2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60º meter.
3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60° meter.

4. Semi-gloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60° meter.

5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60° 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. Label each sample for location and application.

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.

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.

1.5 Contractor shall notify the University's Representative prior to the application of each coat of primer and paint to verify color and coating system.

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 50º and 90ºF.

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.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

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.

3. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

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. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

9. 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 non-complying 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
   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. Zinc-Coated Metal: Provide the following finish systems over zinc-coated metal:

   a. Primer: Galvanized metal 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) 5725 DTM Primer/Finish
      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 Enamel
      3) Or equal.

3.8 EXTERIOR PAINT SCHEDULE

A. Zinc-Coated Metal: Provide the following finish systems over zinc-coated metal:

   a. Primer: Galvanized metal 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) 5725 DTM Acrylic Metal Primer
      2) Sherwin-Williams Co. (S-W) B66W00310 Pro Industrial Pro-Cryl Universal Acrylic Primer.
3) Or equal.

b. First and Second Coats: Semi-gloss, 100% acrylic-latex, exterior-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) 1250 Acry-Shield 100% Acrylic Semi-gloss


3) Or equal.

END OF SECTION 09 91 00
DIVISION 10
SPECIALTIES
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work under this Section shall include all necessary services, labor, materials and product to fabricate and install all sign and /or graphic items included in the documents which consist of Design Drawings and Specification, Graphic Schedule and Location Plans.

B. University to provide 8-½” x 11” drawings of each standard sign type which indicates size, profile and dimensional requirements.

C. University shall be responsible in identifying code compliant sign requirements and location, utilizing standard sign types when applicable.

D. University shall be responsible for a coded signage program identifying quantity, text and graphics required for each sign. In addition, the University shall provide floor plans that correlates to program.

1. Work specified in this section, but not limited to the following:

   a. Panel Signs.

   b. Dimensional letters and numbers.

   c. Photoluminescent egress path marking system.

1.2 CONDITIONS AND GENERAL REQUIREMENTS

A. Engineering and Code Requirements: Sign Contractor shall provide all engineering of sign and graphic items including but not limited to, any items over 20 lbs., mechanical parts and ceiling connections. All items shall be engineered to satisfy all applicable codes and regulations including ADA. Sign Contractor shall obtain and pay for all required permits.

1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.

B. Copy Patterns: All sign copy or graphics (lettering and numbers) are included in the documents for information only. Sign Contractor shall produce film positives made by photo type position or computer generated method. Large copy shall be enlarged in stages using optical, photographic or computer graphics equipment as required to achieve precise reproduction of all elements. Submit two (2) sets of representational copy in blueline form, with sign panel outline shown and using solid copy to University's Representative for approval for all sign types.
C. Samples: Submit two (2) 8" x 8" samples to University's Representative for approval of the surface sheen and treatment of all exposed materials such as metals, plastics, vinyl and glass.

D. Paint Color Samples: Provide two (2) samples of each color on an 8" x 8" square of the actual material that paint or ink is being applied to, to accurately depict the final finish coat to submit to University's Representative for approval.

E. Paint Materials: Submit technical specifications for approval of all proposed paint and finishing materials to meet or exceed the quality of the following:

1. As a primer on galvanized or bare metal surfaces use an etching primer, as recommended by the paint manufacturer.

2. As an undercoat use a primer sealer, as recommended by the paint manufacturer.

3. After proper sanding and cleaning, apply a minimum of two (2) coats of premium quality two step linear polyurethane which meets all California environmental requirements (VOS).

4. After proper sanding and cleaning, apply premium quality acrylic latex multi-color system which meets all California environmental requirements (VOS).

F. Prototypes: These must be approved by University's Representative prior to fabrication. Submit prototypes of any details that may affect design intent/exterior appearance, such as panel edge treatment. Submit one (1) prototype of each of the following complete with copy: Sign Types 5, 13, 9, 18, 19 and one letter from ST 11. Submit prototypes to University's Representative for approval prior to proceeding with production of the specific sign type. Samples will be used on project if approved by University's Representative.

1.4 QUALITY ASSURANCE

A. Sign Fabricator Qualifications: Firm experienced in producing signs similar to those indicated for this Project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.

B. Single-Source Responsibility: For each separate sign type required, obtain signs from one source of a single manufacturer.

1.5 PROJECT CONDITIONS

A. Verification of Existing Conditions and Documents: Sign Contractor shall visit the Site to inspect all existing conditions and to verify all dimensions which are related to the fabrication and/or installation of sign or graphic items. Sign Contractor shall thoroughly review these documents, checking conditions and dimensions shown. Notify University's Representative of any discrepancies in the documents. Written dimensions shall have precedence over scaled dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
2.2 MATERIALS

A. Aluminum Plate: Provide flat plate stock or extruded material (not rolled stock), in thickness as shown on drawings, alloy #3003, H14 mill finish or as required to meet fabrication or engineering requirements. Brush finish to be #6, direction of grain per design drawings.

B. Acrylic Plastic: Provide Plexiglas as manufactured by Rohm & Haas or equal. Finish shall be non-glare with fine sanded edges.

C. Hardware: Provide and install all incidental hardware necessary for the proper functioning of the sign. Hardware shall be stainless steel unless noted otherwise.

D. Exposed Fasteners: Exposed fasteners shall be permitted only where specifically stated in the drawings, and shall be stainless steel, and painted or finished to match adjacent surfaces, unless otherwise specified. Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.

E. Concealed Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.

F. Stainless Steel Items: Provide a low carbon content stainless steel, alloy #302 or #304 of 18 gauge or thickness as necessary. If decorative or readily visible, verify finish and direction of grain with University's Representative or as indicated on drawings.

G. Vinyl: Shall be premium grade unless otherwise specified, with a minimum five (5) year exterior and seven (7) year interior guarantee.

2.3 FABRICATION

A. General: After Sign Contractor has inspected the site to verify conditions and has started with the Work, Contractor shall proceed as per established schedule without delays.

B. The Graphic Schedule shall be followed for quantity of sign items, message wording and references to the Drawings. The Specifications shall have precedence over information noted on the Drawings.

2.4 PROJECT COLORS

A. Paint:

1. P1 WHITE: Sinclair "White".
2. P2: GREY: PPG 32974 "Graphite".
4. P4: Aquafleck™ Latex Multicolor #17378A.
5. P5: ORANGE: Frazee AC108Y "Serengeti Sun".
2.5 COPY APPLICATION

A. Copy application and placement of copy shall follow the dimensions and spacing indicated on the Design Drawings and/or approved copy patterns. Letter spacing shall conform to standards shown and kerned optically to the acceptance of the University. Lines of copy shall be straight and parallel to the sign format, unless otherwise specified. Edges of letters, number and symbols shall be smooth and continuous, with straight and curved portions reproducing the original forms exactly, with corners sharp and true. Pay particular attention to rounded letter forms, as these extend slightly above and below the normal line of copy. All form shall be free of ticks, line waiver, discontinuous curves and other imperfections.

B. Font to be Gerber Frutiger 55 and room numbers to be Gerber Frutiger 65 unless otherwise noted in the Design Drawings and must be ADA compliant.

2.6 PROJECT COLORS

A. As per University standards.

2.7 PHOTOLUMINESCENT EGRESS PATH MARKING SYSTEM

A. Manufacturers:
   1. Balco, Inc. Products:
      a. IllumiTread Demarcation Strips #4211C.
      b. IllumiTread Obstruction Demarcation Strips #4211.
      c. IllumiTread 1” Handrail Strips #4010C.
      d. IllumiTread Stair Nosing with 1” Photoluminescent #4120.
      e. IllumiTread Directional Signage.
   2. Active Safety.
   4. Substitutions: Under provisions of Section 01 60 00.

B. Materials:
   1. Aluminum: ASTM B221, alloy 6063-T5 for extrusions.
   2. Photoluminescent: Phosphorescent pigment, Strontium Aluminate Oxide, combined with a carrier/fixer that is cross-linked to an aluminum substrate at high temperature. PVC based pigment systems shall not be acceptable. Conforms to the following requirements:
b. Illumination: ASTM E2072, having a minimum brightness (luminance) of
30 millicandleas per square meter after 10 minutes and 5 millicandleas
per square meter after 90 minutes.

c. Brightness Rating shall exceed New York City Reference Standard RS
6-1 and 6-1A of BR: 30-7-5 when tested in accordance with ISO 17398.

d. UV Degradation: 2000 hours tested in accordance with ASTM G155:
Pass.


g. Rate of Burning: ASTM D635: Complies.


i. Toxicity Testing: Bombardier SMP800-C “Toxic Gas Generation Test”:
Pass.


3. Abrasive: Two part epoxy combined with aluminum oxide grit.

4. Labeling: Products shall exhibit manufacturer’s name and model number.

5. Fasteners required for complete installation to manufacturer’s instructions.

   a. Handrail strip and demarcation way finding strip shall be attached with a
factory approved adhesive.

   b. Door and Directional signs shall be attached with a factory approved
adhesive.

C. Fabrication:

1. Fabricate stair nosing assemblies as detailed. Provide anchors and accessories
indicated in the installation instructions and necessary for complete installation.

   a. Provide abrasive treads in color selected by Architect from
manufacturer’s full range of standard colors.

   b. Provide specified anchors, and where required, tread plate securing
screws.

   c. Surfaces embedded in concrete shall be coated with a clear acrylic
lacquer.
2. Fabricate handrail illumination strips, demarcation way finding strips, obstacle markers and door and directional signs using phosphorescent pigment Strontium Aluminate Oxide combined with a carrier/fixer that is cross-linked to an aluminum substrate at high temperature.

D. Finishes:

1. Aluminum sub-channels and tread plates shall be:
   a. Mill finish.

2. Slip resistant surfaces shall be black abrasive ribs.

PART 3 - EXECUTION

3.1 FINISHING

A. Painting: Surfaces of all items requiring a painted finish shall be properly prepared. Tool marks and other imperfections shall be filled and sanded or buffed out. Clean surface before applying paint or letter by removing all chalk, dust, dirt, grease and oils. Sufficient primer coats or undercoats shall be applied to achieve a smooth and uniform surface. All painted items shall be spray-painted in a dust free booth, following the paint manufacturer's recommendations concerning thinning and application. Apply additional coats when undercoats, stains or other condition show through the color coat of paint, until paint is of a uniform finish, color and appearance.

1. Linear Polyurethane Paint: Provide pretreatment and primer in accordance with manufacturer's recommendation. Add ultra-violet inhibitors to paint subject to sunlight exposure.

2. Clear Linear Polyurethane Finish: Provide pretreatment, primer and gloss finish in accordance with manufacturer's recommendation. Apply 1.5 to 2 mils to dry film thickness.

3. Latex Multi-Colored System: Provide pretreatment and primer in accordance with manufacturer's recommendation.

B. Individual Cut-Out Letters: Provide individual cut-out letters from Bronze in thicknesses and finishes as noted on the Drawings, Computer Laser Cut or Water-Jet Cut as provided by Architectural Fabricators, Sacramento, CA or equal. The edges of all letters shall be fine sanded smooth without imperfections and finished as noted on Drawings.

3.2 INSTALLATION

A. Job Conditions: Contractor shall examine the site conditions for all sign locations. Submit notes of conditions detrimental to the proper and timely completion of the Work to the University's Representative. The Work shall not proceed until satisfactory conditions have been corrected.

B. Sign Installation: Shall be carried out in a neat and proper manner equal to the finest quality standards of the industry.
C. Location Drawings: Shall be followed when installing signs and graphic items. Item numbers which are found in the Graphic Schedule identify specific sign units and their locations. Drawing show general location for each sign. Specific locations shall be determined by walking the Site with the University's Representative. Contractor shall post a coded water-resistant label at each sign location during walk-through.

D. Installed Signs: Shall be clean, properly aligned, level and true to line and dimension, flush to surface or as detailed and specified, free of excess visible adhesive, if used. Damage to sign or surrounding surfaces or other imperfections will not be accepted. Any code required labels and shut-off switches to be on exterior of sign shall be concealed from normal viewing and all other labels shall be located inside the sign enclosure.

E. Pin Fasteners: Where pins or other mechanical fasteners are used, also provide silicone or epoxy adhesive to prevent unauthorized removal of signs. All fasteners, structures and units must be structurally sound and comply with all applicable codes requirement and restrictions, including state seismic regulations.

F. Protective Materials: Wrappers, covering, identifying stickers, paper etc., shall be removed from the sign at completion of installation.

G. Photoluminescent Egress Path Marking System: Install specified items in accordance with manufacturer's installation instructions and CBC Section 1024 in the locations indicated on the Drawings.

1. Work shall be aligned plumb, level and, where required, flush with adjacent surfaces.

2. Stair and leading edge nosing shall be rigidly anchored to the substrate.
   a. Install full length of each tread and landing nosing.

3. Handrail illumination strips shall be adhered to the handrails with the factory approved adhesive.
   a. Place strips on the top surface of the handrail for the entire length, with the exception of directional change areas of the handrail, including handrail extensions and newel post caps.
   b. At bends or corners, the stripe shall be as continuous as practicable with no more than a 4 inch gap in the photoluminescent strip.

4. Demarcation way finding strips shall be adhered with the factory approved adhesive. Strips shall be as continuous as practicable with no more than a 4 inch gap in the photoluminescent strip.

5. Obstacle Markings: Mark all obstacles at or below for 6 feet-6 inches in height and projecting more than 4 inches into the egress path.

6. Door signage shall be adhered and placed at a maximum height from the floor of 18 inches.
   a. Door hardware shall be marked with no less than 16 square inches of photoluminescent material and the photoluminescent material shall be located behind, immediately adjacent to, or on the door handle and/or
escutcheon. Panic devices shall have a minimum 1 inch x 16 inch photoluminescent strip along their entire length. The strip shall be mounted adjacent to the panic device, but not impede its operation.

b. The top and sides of the door frames shall be marked with a solid and continuous 1 inch wide photoluminescent strip with a factory approved adhesive. Strip is permitted to be installed on the wall surrounding the door frame.

7. Verify that the installed photoluminescent surfaces will be exposed to sufficient activating illumination (a minimum of 1 foot-candles) to ensure the photoluminescent strip will be effectively charged and will meet the required brightness rating.

3.3 FINAL CORRECTIVE WORK

A. Damage to signs or surrounding surfaces shall be repaired to the satisfaction of the University's Representative at no additional cost to the University.

3.4 CLEANING AND PROTECTION

A. During the process of work, remove daily all discarded materials, rubbish, cans, rags, etc., from the Project site.

B. Upon completion of paint work, clean or repaint all paint splattered signs and adjacent surfaces. Remove splattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

C. At completion of installation, clean all sign surfaces in accordance with manufacturer's instructions. Protect units from damage until acceptance by the University's Representative. Repair or replace damaged units as directed by the University's Representative at no additional cost to the University.

1. Check all items for correct placement.

2. Remove all packing material and debris from the site and leave premises in clean condition.

3. Take special precautions to protect finishes.

4. Clean sign material using only cleaners and methods in accordance with the manufacturer's instructions.

3.5 GUARANTEE

A. All Product and Work shall be guaranteed for one (1) year from acceptance against cracking, crazing, peeling, blistering, delamination and other defects in material and/or workmanship.

B. All vinyl shall be guaranteed for five (5) years.

C. Furnish a one (1) year warranty, warranting that the paint finishes will not develop non-uniformity of color or fading and will not crack, peel, pit, corrode or otherwise fail as a result of defects in material or workmanship within the following defined limits. Upon
notification of such defects, within the warranty period, make necessary repairs or replacement at the convenience of the University.

1. Fading: A change in appearance which is perceptible and objectionable as determined by the University's Representative when visually compared with the original color range standards.

2. Non-Uniformity: Non-uniform fading to the extent that adjacent panels have a color difference greater that the original range of color.

3. Will Not Pit or Otherwise Corrode: No pitting or other type of corrosion, discernible from a distance of 10’, resulting from the natural elements in the atmosphere at the project site.

D. Photoluminescent Egress Path Marking System: Submit manufacturer’s warranty that materials furnished will perform as specified for a period of not less than five years when installed by a manufacturers certified installer in accordance with manufacturer’s recommendations and that the photoluminescent glow properties have a projected life expectancy of 25 years.

END OF SECTION 10 14 00
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 and Corner 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 and Corner 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. Bumper-Rail-Type Wall Guards: Continuous, snap-on-type plastic cover installed over a continuous aluminum retainer mounted at height indicated.

1. Cover: Extruded, rigid plastic, minimum 0.078" thick, in dimensions and profiles indicated.

2. Retainer: Continuous, one-piece, extruded-aluminum retainer; minimum 0.072" thick.
   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 HANDRAILS

A. Bumper-Rail-Type Handrails: Impact-resistant, resilient handrail assembly consisting of a snap-on plastic cover installed over a continuous aluminum retainer mounted at height indicated. Comply with ANSI/CABO A117.1.

1. Cover: Extruded, rigid plastic, minimum 0.078" thick, in dimensions and profiles indicated.

2. Retainer: Continuous, one-piece, extruded-aluminum retainer; minimum 0.081" thick; with continuous rubber or vinyl bumper cushion centered in the extrusion.

3. Mounting Bracket: Extended mounting on high-impact, prefabricated, injection-molded, plastic mounting brackets. Provide mounting hardware and other accessories as required.
4. Accessories: Provide prefabricated, injection-molded end caps and inside and outside corners with concealed splices, cushions, 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.

2.5 CORNER GUARDS

A. Surface-Mounted, Resilient Plastic Corner Guards: Surface-mounted, resilient plastic corner-guard assembly consisting of a snap-on-type plastic cover installed over a continuous aluminum retainer, height as indicated.


1. Cover: Extruded, rigid plastic, minimum 0.078" thick, in dimensions and profiles indicated.
   a. Corner Radius: ¼".
   b. Corner Radius: 1-¼".

2. Retainer: Continuous, one-piece, extruded-aluminum retainer; minimum 0.062" thick.

3. Accessories: Provide prefabricated, injection-molded top cap and aluminum base with concealed splices, cushions, mounting hardware, and other accessories as required.
   a. Top caps shall match color of plastic covers and shall be field adjustable for close alignment with snap-on plastic covers.

C. Stainless-Steel Corner Guards: Paper-covered, satin-finish, 0.0625" minimum, stainless-steel sheet corner guards; height as indicated. Provide 90° turn, unless otherwise indicated; and formed edges.

2.6 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.

2.7 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.

2.8 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.

2.9 STAINLESS-STEEL FINISHES
A. Satin, Directional Polish: No. 6 finish.
   1. Remove tool and die marks and stretch lines or blend into finish.
   2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

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.

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
SECTION 10 44 00
FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Work under this Section includes all materials and installation necessary to provide Fire Extinguishers and Cabinets, as shown and detailed on the drawings and specified herein.

B. Related Work Specified Elsewhere:

1. Division 09, Section 09 22 16 – METAL STUD SYSTEM.

2. Division 09, Section 09 29 00 – GYPSUM BOARD.

1.2 QUALITY ASSURANCE

A. References:

1. American National Standards Institute:


B. Qualifications: Installer specializing in the work of this Section with minimum three (3) years documented experience; manufacturer and approved.

1.3 SUBMITTALS

A. General: Refer to Section 01 33 23 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Product Data: None required for specified products; required for alternate products.

C. Certificates: Submit manufacturer's certificate stating that materials meet or exceed specified requirements.

1.4 PRODUCT HANDLING

A. General: Refer to Section 01 31 00 – COORDINATION.

1.5 SITE CONDITIONS

A. Environmental Requirements: Do not install when temperatures may cause freezing of extinguisher ingredients.
1.6 MAINTENANCE

A. General: Refer to Section 01 77 00 – CLOSEOUT PROCEDURES.

B. Maintenance Data: Manufacturer's instructions.

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. Manufacture:

1. Amerex Corp.: Amerex Model #441 10lbs. 4A:60BC dry chemical fire extinguisher, or equal, no known equal; match existing hanger.

B. Cabinets:

1. Mounting: Semi recessed mounted; fire rated where indicated on Drawings. Refer to the Construction Documents for the type and location.

2. Material and Finish:
   a. General: White tub with red door and trim.
   b. Size: 12” wide x 24” high x 8” deep.
   c. Door Style: Door to be glass panel in metal frame. Latch is to be roller latch for in-door locations and lockable break glass for outdoor locations.
   d. Glazing: Tempered glass; color as selected by University's Representative.
   e. Lettering: Manufacturer's standard, horizontal; color as selected by University's Representative.

C. Extinguishers:

1. Extinguishers must have current service tag with monthly sign-off lines on reverse of tag.

2. General: Fire fighting devices must be listed by Underwriters' Laboratories, Inc., bear a UL label, and be approved by the California State Fire Marshal.

D. Fasteners: As recommended by manufacturer.
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.

3.2 INSTALLATION

A. General: Install in conformance with referenced standards, manufacturer’s written directions, as shown, and as specified.

B. Cabinets: Where shown; anchor components firmly in place.

C. Wall Brackets: Install as required by codes and regulations or as shown; anchor components firmly in place.

D. Extinguishers:

   1. Cabinet: One (1) extinguisher for each cabinet.

3.3 FIELD QUALITY CONTROL

A. Service: Inspect, charge and tag fire extinguishers not more than ten (10) days prior to occupancy of building by University’s Representative.

3.4 ADJUSTMENT

A. General: Prior to acceptance of cabinets, adjust moveable door parts to assure smooth operation.

3.5 CLEANING

A. General: Upon completion, thoroughly clean exposed surfaces per manufacturer's instructions.

END OF SECTION 10 44 00
SECTION 10 51 00
LOCKERS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Locker units with hinged doors.
B. Hardware.
C. Accessories.

1.2 RELATED SECTIONS
A. Section 03 30 00 – Cast-In-Place Concrete.
B. Section 09 22 16 – Metal Stud System: Metal blocking/backing.
C. Section 09 29 00 – Gypsum Board.

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. Standards, manuals, and codes refer to the latest edition of such standards, manuals, and codes in effect as of the date of issue of this Project Manual, unless indicated otherwise in CBC Chapter 35 and CFC Chapter 80.
C. Referenced Standards:
   1. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. CBC – 2016 California Building Code, Chapter 11B.

1.4 SUBMITTALS
A. Submit under provisions of Division 01.
B. Shop Drawings: Indicate locker plan layout, locker elevations, numbering plan, and anchorage details.
C. Product Data: Provide data on locker types, sizes, and accessories.
D. Samples: Submit two samples, 3 inches x 6 inches in size, of color selected; applied to specified base metal.
E. Manufacturer's Installation Instructions: Indicate component installation.

1.5 SYSTEM DESCRIPTION
A. Locker Units:
   1. Width: 12 inches.
2. Depth: 12 inches.
3. Height: 12 inches.
7. Locking: Equipped for padlocks.
8. Ventilation Method: Door louvers.

1.6 DELIVERY, STORAGE AND HANDLING
A. Deliver, store, protect, and handle products to site under provisions of Division 01.
B. Protect locker finish and adjacent surfaces from damage.

1.7 FIELD MEASUREMENTS
A. Verify that field measurements are as indicated on shop drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Acceptable Manufacturers:
   2. Republic Storage Products, LLC.
   3. Penco Products, Inc.
B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS
A. Sheet Steel: ASTM A653/A653M galvanized to G90 coating, stretcher leveled; to the following minimum thicknesses:
   2. Door Face: 16 gauge.
   3. Door Frame: 16 gauge.

2.3 FABRICATION
A. Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.
B. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.

C. Doors: Hollow construction, manufacturer's standard thickness, channel reinforced top and bottom.

D. Hinges: Two for doors under 42 inches high; three for doors over 42 inches high; pop rivet securely to locker body and door.

E. Locking devices supplied by Owner.

F. Number Plates: Provide rectangular shaped plates. Form numbers 3/8 inch high of block font style, in contrasting color.

G. Provide ventilation openings at top and bottom of each locker.

H. Finish edges smooth without burrs.

2.4 ACCESSORIES

A. Provide Manufacturer’s slope top kit.

2.5 FINISH

A. Clean, degrease, and neutralize metal; prime and finish with one coat of baked enamel. Color as selected by Architect from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lockers in accordance with manufacturer's instructions.

B. Fasten lockers to floor and walls per manufacturer's recommendations to meet CBC seismic requirements.

C. Secure lockers with anchor devices to suit substrate materials. Minimum pullout force per anchor: 100 pounds.

D. Install lockers plumb and square.

E. Bolt adjoining locker units together to provide rigid installation.

F. Install sloping tops and metal fillers using concealed fasteners. Provide flush hairline joints against adjacent surfaces.

3.2 ADJUSTING

A. Adjust doors, latches, locks, and operating hardware to function properly for smooth operation without binding. Verify that latches are operating satisfactorily.

B. Touch-up with factory-supplied paint and repair or replace damaged products.

3.3 CLEANING

A. Clean work under provisions of Division 01.
B. Clean interior and exterior surfaces in accordance with manufacturer’s recommendations.
   1. Do not use harsh cleaning products or methods that could damage finish.

3.4 PROTECTION
   A. Protect installed products through completion of project.

END OF SECTION 10 51 00
DIVISIONS 11 – 20
NOT USED
DIVISION 21
FIRE SUPPRESSION
PART I - GENERAL

1.01 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, 2005 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, 2005 edition or latest code adopted by authority having jurisdiction. The work must also be in accordance with all local or state requirements which apply.

1.02 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.

1.03 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.

1.04 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 15 Basic Mechanical Materials and Methods section 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 15 Basic Mechanical Materials and Methods section 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 15 Basic Mechanical Materials and Methods section 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 15 Basic Mechanical Materials and Methods sections, 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 15 Basic Mechanical Materials and Methods sections, 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, Automatic Sprinkler Corporation of America, Model J-2.5, or equal, no known equal.
   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 Automatic Sprinkler Corporation of America, Model J-2.5, or equal, no known equal.
3. Sidewall Locations: Where required and where approved by the University's Representative shall be Automatic Sprinkler Corporation of America, Model J-2.17, or equal, no known equal.

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. Automatic Sprinkler Corporation of America, Model J-2.23, or equal, no known equal.

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 15 Basic Mechanical Materials and Methods section.
   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 15 Basic Mechanical Materials and Methods section.
   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 the SMACNA "Guidelines for Seismic Restraint of Mechanical Systems and Plumbing Piping Systems", and OSHPD if project is under their jurisdiction.

G. Make connections to water stub covered in civil work with fittings suitable for the particular conditions encountered.

H. Provide changes in direction with anchors or thrust blocks. Terminate supply lines inside buildings with a special flange and spigot piece, with flange set not less than 4” above floor.
   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 15, Basic Materials and Methods sections. 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 15 Basic Mechanical Materials and Methods sections.

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
DIVISION 22
PLUMBING
SECTION 22 05 00
PLUMBING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 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.

1.2 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)

1.3 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.
PLUMBING GENERAL REQUIREMENTS

13. Uniform Mechanical and Plumbing Codes with applicable State of California amendments
14. Commercial and Industrial Insulation Standards.
17. Sheet Metal and Air conditioning Contractor’s National Association Standards.
19. American Welding Society

1.4 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.

1.5 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 that bear the UL label where such label is applicable.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protect materials from corrosion and breakage. Store materials above grade. Provide
appropriate covering.

1.7 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.

1.8 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.

1.9 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. As-built Drawings.
7. Air Systems Balance Reports.

1.10 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 "Record Drawings".

H. Refer to specification section 01 77 00 for further closeout instructions.

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 4119 - 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.

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.

C. Refer to specification section 01770 for further closeout instructions.

END OF SECTION 22 05 00
SECTION 22 05 01
PLUMBING TRENCHING AND BACKFILL

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. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect.
   2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

   1. Classification according to ASTM D 2487.
   2. Laboratory compaction curve according to ASTM D 698.

C. Seismic survey report from seismic survey agency.

D. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.5 TRENCH SAFETY PROVISIONS

A. Before beginning excavation for a trench 5 feet or more in depth, Contractor shall submit to and receive acceptance by Governmental Authorities of a detailed plan showing design of shoring, bracing, sloping, or the provisions to be made for worker protection.

B. Nothing herein shall be deemed to allow the use of shoring, sloping or protective system less effective than that required by Federal, State, and/or Local laws.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. The following practices are prohibited within protection zones:

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

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

J. Sand: ASTM C 33; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

   a. 24 inches outside of concrete forms other than at footings.
   b. 12 inches outside of concrete forms at footings.
   c. 6 inches outside of minimum required dimensions of concrete cast against grade.
   d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
   e. 6 inches beneath bottom of concrete slabs-on-grade.
   f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

3.4 EXCAVATION FOR UTILITY TRENCHES

A.Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

E. Shoring: Brace, shore sides, or increase width of excavations as necessary to prevent cave-ins, and as necessary to protect employees as required by applicable Federal, State and local laws. Repair slides and cave-ins should they occur. Remove shoring before backfilling.

1. At the pit excavation for Ejector Pump, provide benching of existing soil as fit to prevent cave-ins.

3.5 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.6 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.
B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings.

D. Trenches under Roadways: Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course.

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Place and compact initial backfill of subbase material, satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.

H. Place and compact final backfill of satisfactory soil to final subgrade elevation.

I. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

J. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.7 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under building slabs, use engineered fill.
   2. Under footings and foundations, use engineered fill.

3.8 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698.
1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.9 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material and maximum lift thickness comply with requirements.
3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

3.10 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.11 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 22 05 01
SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Escutcheons.
   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 polished, chrome-plated 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 220518
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.

2. **Standard:** ASME B40.200.
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.

9. **Connector:** 1-1/4 inches, with ASME B1.1 screw threads.
10. **Accuracy:** Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

### 2.4 THERMOWELLS

**A. Thermowells:**

1. **Standard:** ASME B40.200.
2. **Description:** Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. **Material for Use with Copper Tubing:** 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.
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. 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 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
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.

B. Related Sections:
   1. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.

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:
   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 electro-galvanized steel 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 A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. 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.

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 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. 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
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.
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.


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.

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.
   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.
   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.
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-fabricate 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
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 and/or insulation material that occurs in either new work connections or damage associated with the demolition of surrounding utilities, by applying same facing material and insulation thickness over damaged areas. Extend patches at least 24" inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. Replace damaged insulation from demolition point to new connection point.

Q. 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:
   B. Rainwater Drain and Overflows:
      1. 8” diameter and Smaller: Insulation shall be one of the following:
         a. Cellular Glass: ½” thick with ASJ.
         b. Insulate first 10 feet of pipe originating at the roof or overflow drain.

END OF SECTION 22 07 19
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.
   3. Trap primers

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 two days in advance of proposed interruption of water 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.
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 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe:
   1. ASTM A 53/A 53M, Type E, Standard Weight.
   2. Include ends matching joining method.
C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
D. Malleable-Iron Unions:
   1. ASME B16.39, Class 150.
   2. Hexagonal-stock body.
   4. Threaded ends.
E. Flanges: ASME B16.1, Class 125, cast iron.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full-face or ring type unless otherwise indicated.
B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 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.

2.6 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 Insert 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.
2.7 WATER-HAMMER ARRESTERS

   A. Water-Hammer Arresters:
      1. Watts, or equal.
      3. Type: Copper tube with piston.
      4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.8 TRAP-SEAL PRIMER DEVICE

   A. Supply-Type, Trap-Seal Primer Device:
      1. Precision Plumbing Products, or equal.
      5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
      6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
      7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 EARTHWORK

   A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 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."

T. Install water-hammer arresters in water piping according to PDI-WH 201.

U. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. 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 seismic-restraint devices in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
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.

   2. Piping Tests:
a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. 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; wrought-copper, solder-joint fittings; and soldered joints.

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, solder-joint fittings; and 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 22 11 16
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.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ANACO-Husky.
      b. No know 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 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.

2.5 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class including square-cut-grooved joining method.


C. Steel Pipe Pressure Fittings:

D. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
   2. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

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.

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 stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.

O. Install aboveground copper tubing according to CDA’s "Copper Tube Handbook."

P. Install force mains at elevations indicated.

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install 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


C. 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.

D. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

E. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

3.4 HANGER AND SUPPORT INSTALLATION

A. 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.

B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. 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.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. 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.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 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.

J. Install supports for vertical stainless-steel piping every 10 feet.

K. 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.

L. Install supports for vertical copper tubing every 10 feet.

M. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.
N. Install supports for vertical ABS and PVC piping every 48 inches.

O. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 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."

3.6 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. 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.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and
allow to stand for four hours. Leaks and loss in pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.7 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 1-1/2 and NPS 2] shall be the following:
   1. Galvanized-steel pipe, pressure fittings, and threaded joints.

G. Aboveground, sanitary-sewage force mains [NPS 2-1/2 to NPS 6] shall be the following:
SECTION 22 13 19
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.
   3. Floor sinks.
   4. Roof/Overflow 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. J.R. Smith.
   b. Tyler Pipe; Wade Div.
   c. Watts Drainage Products Inc.
   d. Zurn Plumbing Products Group; Specification Drainage Operation.
   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. J.R. Smith.
   b. Tyler Pipe; Wade Div.
   c. Watts Drainage Products Inc.
   d. Zurn Plumbing Products Group; Light Commercial Operation.
   e. Josam Company; Blucher-Josam Div.
   f. 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. J.R. Smith.
   b. Tyler Pipe; Wade Div.
c. Watts Drainage Products Inc.
d. Josam Company; Blucher-Josam Div.
e. Zurn Plumbing Products Group; Specification Drainage Operation.
f. 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. J.R. Smith
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Josam Company; Blucher-Josam Div.
   f. Zurn Plumbing Products Group; Light Commercial Operation.
   g. Or equal.

2.3 FLOOR SINKS

A. Enameled 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. J.R. Smith
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Josam Company; Blucher-Josam Div.
   f. Zurn Plumbing Products Group; Light Commercial Operation.
   g. Or equal.

2.4 METAL ROOF DRAINS

A. Cast-Iron, Medium-Sump, General-Purpose Roof Drains:

1. Zurn, or equal.
4. Dimension of Body: 12-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Outlet: Bottom.
7. Dome Material: Cast iron.

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 22 13 19
SECTION 221343 - FACILITY PACKAGED SEWAGE PUMPING STATIONS

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 wet-well, packaged pumping stations with submersible chopper sewage pumps.

1.3 PERFORMANCE REQUIREMENTS

A. Pressure Rating of Sewage Pumps and Discharge Piping Components: At least equal to sewage pump discharge pressure, but not less than 125 psig.

B. Pressure Rating of Other Piping Components: At least equal to system operating pressure.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Show fabrication and installation details for each packaged sewage pumping station. Detail equipment assemblies and indicate dimensions; shipping, installed, and operating weights; loads; required clearances; method of field assembly; components; electrical characteristics; and location and size of each field connection.


1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of sewage pump, signed by product manufacturer.

B. Qualification Data: For installer.

C. Source quality-control test reports.

D. Field quality-control test reports.

E. Warranly: Special warranty specified in this Section.
1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For equipment to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

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.


1.8 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewer Service: Do not interrupt sanitary sewer service to facilities occupied by University or others unless permitted under the following conditions and then only after arranging to provide temporary sanitary sewer service according to requirements indicated:

1. Notify University's Representative no fewer than two days in advance of proposed interruption of sanitary sewer service.
2. Do not proceed with interruption of sanitary sewer service without University's Representative's written permission.

1.9 COORDINATION

A. Coordinate size and location of concrete cast in place sewage pits.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged sewage pumping stations that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of sewage pumps, controls, or accessories.

b. Deterioration of metal, metal finishes, and other materials beyond normal use.

2. Warranty Period for Sewage Pumps and Controls: 5 years from date of Substantial Completion.

3. Warranty Period for Accessories: 5 years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 PACKAGED SEWAGE PUMPING STATIONS

A. Packaged Sewage Pumping Stations with Submersible Chopper Sewage Pumps:

1. Description: Factory fabricated, assembled, and tested with sewage pumps designed for installation in cast-in-place wet wells and collection of sanitary sewage and with dry equipment chamber for controls and accessories.

2. Basis of Design Manufacturer – Vaughan.


2.2 CONTROLS

A. Control Sequence of Operation: Cycle each sewage pump on and off automatically to maintain wet-well sewage level. Automatic control operates both pumps in parallel if wet-well level rises above starting point of low-level pump, until shutoff level is reached. Automatic alternator, with manual disconnect switch, changes sequence of lead-lag sewage pumps at completion of each pumping cycle.

B. Float-Switch System: Senses variations of sewage level in wet well. Include high and low adjustments capable of operating on 6-inch minimum differential of liquid level.

C. Motor Controllers: Magnetic, full voltage, nonreversing. Include undervoltage release, thermal-overload heaters in each phase, manual reset buttons, and hand-automatic selector switches. Include circuit breakers to provide branch-circuit protection for each controller.

D. 120-V accessory controls with 15-A, single-phase circuit breakers or fuses for each item.

E. Control Panel: Enclosure complying with UL 508A with separate compartments and covers for controllers, circuit breakers, transformers, alternators, and single-phase controls. Include 20-A duplex receptacle in NEMA WD 1, Configuration 5-20R mounted on exterior of control panel.

   2. Enclosure: NEMA 250, Type 1.

F. Control panel display and alarms: Run lights and failure lights for each pump. 90dB audible alarm with push-to-silence button.

   1. Auxiliary alarm output for high water level, pump fail, and power failure.

G. Install labels on panel face to identify switches and controls.

H. Wiring: Tin-copper wiring.

2.3 MOTORS

A. General requirements for motors are specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
2.4 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 6/A 6M, W or HP shapes, or ASTM A 36/A 36M, plates or beams.

B. Grout: ASTM C 1107, Grade B, nonshrink cement grout.
   1. Design Mix: 5000-psi, 28-day compressive strength.

2.5 PACKAGED SEWAGE PUMPING STATION FABRICATION

A. Factory fabricate piping between unit components.
   1. Use galvanized-steel pipe and cast-iron fittings or ductile-iron pipe and fittings.
   2. Use fittings for changes in direction and branch connections.
   3. Flanged and union joints may be used instead of joints specified.
   4. Use dielectric fittings for connections between ferrous- and copper-alloy piping.

B. Piping Connections: Unless otherwise indicated, make the following piping connections:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection
ten piece of equipment having NPS 2 or smaller threaded pipe connection.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final
connection to each piece of equipment having flanged pipe connection.

C. Valves: Ferrous alloy.
   1. Sewage Pump Piping: Include gate valve on each pump inlet and gate and check valves
   on each discharge pipe.

D. Wiring: Tin-coated copper.

2.6 SOURCE QUALITY CONTROL

A. Test and inspect sewage pumps according to HI 1.6, "Centrifugal Pump Tests." Include test
recordings that substantiate correct performance of pumps at design head, capacity, suction lift,
speed, and horsepower.

B. Test accessories and controls through complete cycle. Include test recordings that substantiate
correct performance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for
installation tolerances and other conditions affecting performance.
B. Examine roughing-in of sewerage piping systems to verify actual locations of piping connections before packaged sewage pumping station installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install packaged sewage pumping station components where indicated, according to specific equipment and piping arrangement indicated.

3.3 CONNECTIONS

A. Sanitary sewer piping installation requirements are specified in Section 221313 "Facility Sanitary Sewers." Drawings indicate general arrangement of piping.

B. Install piping adjacent to machine to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

A. Install identifying labels permanently attached to equipment.

B. Install operating instruction signs permanently attached to equipment or on pumping station wall near equipment.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform field tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

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.

D. Tests and Inspections:

1. After installing packaged sewage pumping stations and after electrical circuitry has been energized, test for compliance with requirements. Furnish water required for pump tests.
2. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Remove and replace packaged sewage pumping stations that do not pass tests and inspections and retest as specified above.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer’s written instructions.
   2. Adjust pump, accessory, and control settings, and safety and alarm devices.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train University’s maintenance personnel to adjust, operate, and maintain packaged sewage pumping stations. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 221343
SECTION 22 43 00
HEALTHCARE PLUMBING FIXTURES

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes the following healthcare fixtures and specialties:
      2. Lavatories.
      3. Electric Drinking Fountains.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include construction details, material descriptions, dimensions of individual components
         and profiles, and finishes for fixtures.
      2. Include rated capacities, operating characteristics, electrical characteristics, and
         furnished specialties and accessories.
   B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For plumbing fixtures and faucets to include in operation and
      maintenance manuals.
      1. In addition to items specified in Section 01 78 23 - Operation and Maintenance Data,
         include the following:
         a. Servicing and adjustments of electronic flush valves and drinking fountains.

PART 2 - PRODUCTS

2.1 HEALTHCARE WATER CLOSETS
      1. Basis of Design manufacturer – Zurn or equal.
      2. Capacity and Performance - See Plumbing Fixture Schedule on Plans.
2.2 LAVATORY

A. Wall Hung Lavatory – ADA compliant.
   1. Basis of Design manufacturer – Zurn or equal.

2.3 ELECTRIC DRINKING FOUNTAINS

A. Single or Dual Wall Mounted Drinking Fountains – ADA compliant.
   1. Basis of Design manufacturer – Elkay or equal.

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers: NPS 1/2 ASME A112.18.6, braided or corrugated stainless-steel, flexible hose.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install healthcare plumbing fixtures level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted fixtures.
   1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
   2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install water-supply piping with stop on each supply to each fixture to be connected to water-distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

D. Install toilet seats on healthcare water closets.

E. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 - Plumbing Piping Insulation.

G. Seal joints between healthcare plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 - Joint Sealants.

H. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 - Escutcheons for Plumbing Piping.

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with requirements for water piping specified in Section 22 11 16 - Domestic Water Piping.

C. Comply with requirements for soil and waste drainage piping and vent piping specified in Section 22 13 16 - Sanitary Waste and Vent Piping.

D. Comply with requirements for atmospheric vent piping specified in Section 22 13 16 - Sanitary Waste and Vent Piping.

E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 - Plumbing Piping Insulation.

3.4 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning healthcare plumbing fixtures, fittings, and controls.

B. Adjust water pressure at drinking fountains and electric flush valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After installing healthcare plumbing fixtures, inspect and repair damaged finishes.
B. Clean healthcare plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed fixtures and fittings.

D. Do not allow use of healthcare plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 43 00
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."

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:
      1. Medical Gas Piping Systems for Healthcare Facilities: According to ASSE
         Standard #6010 for medical-gas-system installers.
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.

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 23 05 13
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. 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.

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 23 05 13
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 23 05 19
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-inchstem 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:
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. 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.
GENERAL-DUTY VALVES FOR HVAC PIPING

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, 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.
8. Iron Gate Valves: [Class 125] [Class 250], [NRS] [OS&Y].
9. Iron Globe Valves, NPS 2-1/2 to NPS 12: [Class 125] [Class 250].

END OF SECTION 23 05 23
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.

B. Related Sections:
   1. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides
      and anchors.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for 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 Pipe and Supports.
3. Equipment supports.

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 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. 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 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. 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. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
   a. Horizontal (MSS Type 54): Mounted horizontally.
   b. Vertical (MSS Type 55): Mounted vertically.
   c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. 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
SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. 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.
   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.


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.

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.


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.

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.
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 230553
SECTION 23 05 93
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.
   3. Duct Leakage Tests:
      a. New air handling equipment and distribution mains onto each floor served, including stair pressurization fan and distribution.

1.3 DEFINITIONS
C. TAB: Testing, adjusting, and balancing.
D. TABB: Testing, Adjusting, and Balancing Bureau.
E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 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."
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 Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.

   1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
   2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB or AABC.

B. TAB Conference: 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.

C. 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.

D. TAB Report Forms: Use standard TAB contractor's forms approved by the Engineer of Record.
E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

G. 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. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine 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.
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.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. 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.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.
9. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system, new and existing, 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. 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. 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. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

K. 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. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

   a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from 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.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.8 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.9 PROCEDURES FOR HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Measure inlet steam pressure.

E. Check settings and operation of safety and relief valves. Record settings.
3.10 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

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. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. 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, including resheaving of fans or VFD adjustment.
(where present) 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 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by installer.
B. Verify that proper test methods are used and that leakage rates are acceptable.
C. Report deficiencies observed.

3.14 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.

3.15 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report’s binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers’ test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
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 airflow 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.

END OF SECTION 23 05 93
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.
3. Outdoor, exposed supply and return.

B. Related Sections:

1. 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 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type 1, unless otherwise indicated.

B. Metal Jacket:

   a. Sheet and roll stock ready for shop or field sizing.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Outdoor Applications: 3-mil thick, heat bonded polyethylene and kraft paper.

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.

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.

2.6 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 "Firestopping" and fire-resistant 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 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end seams. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches on center and at end joints.

3.7 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed return located in unconditioned space.
   4. Indoor, exposed return located in unconditioned space.
   5. Outdoor, exposed supply and return.

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.
3.8 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.

3.9 OUTDOOR DUCT INSULATION SCHEDULE

A. Exposed, rectangular, supply air duct insulation shall be the following:

B. Exposed, rectangular, return air duct insulation shall be the following:

3.10 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Ducts, Exposed, up to 48 inches in diameter or with Flat Surfaces up to 72 inches:
   1. Aluminum, Corrugated, 0.040 inch thick.

END OF SECTION 23 07 13
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:
2. HVAC PIPING INSULATION


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:

c. Pittsburgh Corning Corporation; Pittseal 444.
d. Or equal.

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 lb/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.
   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
PART 1 - GENERAL

1.1 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.

1.2 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.

1.3 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).

1.4 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.

1.5 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.

1.6 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 range-ability 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 a TCP 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 data 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 back up 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.

ey. 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 23 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 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.

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 label. 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.

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. Anvil International, Inc.
   b. Victaulic Company.
   c. Or equal.

2. Grooved-End Copper Fittings: ASTM B 75 copper tube or ASTM B 584, bronze casting.
3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 230 deg Ffor use with housing, and steel bolts and nuts.

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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. 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. Anvil International, Inc.
   b. Victaulic Company.
   c. Or equal.

4. 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.

5. 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-inch maximum thickness unless thickness or specific material is indicated.

      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

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. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.


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:
   b. Matco-Norca, Inc.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   e. Wilkins; a Zurn company.
   f. Or equal.

2. Description:
   b. Pressure Rating: 125 psig minimum at 180 deg F
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Matco-Norca, Inc.
      b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      c. Wilkins; a Zurn company.
      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:
      2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      3. 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. Armstrong Pumps, Inc.
         b. Bell & Gossett Domestic Pump; a division of ITT Industries.
c. Griswold Controls.
d. Taco.
e. Or equal.

4. Body: Bronze, ball or plug type with calibrated orifice or venturi.
5. Ball: Brass or stainless steel.
6. Plug: Resin.
7. Seat: PTFE.
8. End Connections: Threaded or socket.
10. Handle Style: Lever, with memory stop to retain set position.
11. CWP Rating: Minimum 125 psig
12. Maximum Operating Temperature: 250 deg F

D. Cast-Iron or Steel, 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. 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. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Griswold Controls.
   d. Taco.
   e. Tour & Andersson; available through Victaulic Company.
   f. Or equal.

4. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
5. Ball: Brass or stainless steel.
7. Disc: Glass and carbon-filled PTFE.
8. Seat: PTFE.
11. Handle Style: Lever, with memory stop to retain set position.
12. CWP Rating: Minimum 125 psig
13. Maximum Operating Temperature: 250 deg F

2.6 AIR CONTROL DEVICES

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:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
C. 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

D. 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

E. 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.

F. 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.

G. 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

H. 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. 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.

B. 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. 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

C. 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 and 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 (DN 50) 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 (DN 65) and larger, shall be of 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 (DN 50) 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 (DN 65) 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 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. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

P. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
Q. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.

R. 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 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).

S. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

T. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

U. 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. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) 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.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (10 mm).
7. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).
8. NPS 6 (DN 150): Maximum span, 17 feet (5.2 m); minimum rod size, 1/2 inch (13 mm).
9. NPS 8 (DN 200): Maximum span, 19 feet (5.8 m); minimum rod size, 5/8 inch (16 mm).
10. NPS 10 (DN 250): Maximum span, 20 feet (6.1 m); minimum rod size, 3/4 inch (19 mm).
11. NPS 12 (DN 300): Maximum span, 23 feet (7 m); minimum rod size, 7/8 inch (22 mm).
12. NPS 14 (DN 350): Maximum span, 25 feet (7.6 m); minimum rod size, 1 inch (25 mm).
13. NPS 16 (DN 400): Maximum span, 27 feet (8.2 m); minimum rod size, 1 inch (25 mm).
14. NPS 18 (DN 450): Maximum span, 28 feet (8.5 m); minimum rod size, 1-1/4 inches (32 mm).
15. NPS 20 (DN 500): Maximum span, 30 feet (9.1 m); minimum rod size, 1-1/4 inches (32 mm).

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

F. 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.

G. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer’s written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

H. Support vertical runs at roof, at each floor, and at 10-foot (3-m) 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 (DN 50) 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 (1200 mm) above the floor. Install feeder in minimum NPS 3/4 (DN 20) bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 (DN 20) 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:
   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.

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
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. McGill AirFlow LLC.
   b. SEMCO Incorporated.
   c. Sheet Metal Connectors, Inc.
   d. Spiral Manufacturing Co., Inc.
   e. Or equal.

B. 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.

C. 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.

D. 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 seals 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] [4 inches] [6 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. Ductmate Industries, Inc.
2. 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. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, expansion-type anchors, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

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.

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. All duct dimensions noted on the drawings are net outside (i.e. 24x24 lined duct is 24x24 sheet metal duct size).

B. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

C. 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

D. Return Ducts:

1. Ducts Connected to Air-Handling Units:
   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 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.

E. 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: 6.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.

F. 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.

G. 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 23 31 13
SECTION 23 33 00
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.

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. McGill AirFlow LLC.
      b. Pottorff.
      c. Ruskin Company.
      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.
8. Tie Bars and Brackets: Galvanized steel.

2.4 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Ruskin Company.
   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.
9. Or equal.


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 90.1.

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 in ducts larger than 8 sqft.
   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. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00
SECTION 23 34 16
EXHAUST 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. Forward-curved centrifugal in-line exhaust 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. Material thickness and finishes, including color charts.
   6. 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. AMCA Compliance:
   1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal for both Sound and Air Performance.
   2. Operating Limits: Classify according to AMCA 99.


2.2 BACKWARD-INCLINED CENTRIFUGAL INLINE EXHAUST FANS
A. Basis of Design Manufacturer – Greenheck or equal.
B. Description:
   1. Factory-fabricated, -assembled, -tested, and -finished, direct-drive centrifugal fans consisting of galvanized steel housing, wheel, direct drive motor, 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. Galvanized steel housing with duct collars.

D. Backward-Inclined Wheels:
   1. Backward inclined aluminum wheel.

2.3 MOTORS
   A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   B. Vari-Green EC motor with 1-10 VDC input signal.
   C. Control: Vari-Green speed controller set at constant volume.

2.4 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. Equipment Mounting: Install in accordance with OSP-0113-10.
   E. Install units with clearances for service and maintenance.
   F. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."
3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

3.3 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 test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

   1. 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. Verify lubrication for bearings and other moving parts.
   5. See Section 230593 "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
   6. Remove and replace malfunctioning units and retest as specified above.

D. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 23 34 16
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 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
   2. 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.
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 23 37 13
SECTION 23 74 13
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 and Stair Pressurization Fans.
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 by products 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 14gauge 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 Galvanized. 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, G90 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 backflow 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 INTERIOR LIGHTS

A. Provide Service Lights and Switches: Factory installed in each accessible section with weatherproof cover. Factory wire lights to a single-point field connection.

2.11 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.

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. 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.

B. 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.

C. 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 safety devices. Replace damaged and malfunctioning controls and equipment.

D. 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 23 74 13
SECTION 23 82 16
HYDRONIC AIR COILS

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 hydronic heating and cooling air coils.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include construction details, material descriptions, dimensions of individual components
         and profiles, and finishes for each air coil.
      2. Include rated capacities, operating characteristics, and pressure drops for each air coil.

1.4 INFORMATIONAL SUBMITTALS
   A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and
      ceiling-mounted access panels are shown and coordinated with each other.

1.5 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For air coils to include in operation and maintenance
      manuals.

PART 2 - PRODUCTS

2.1 DESCRIPTION
   A. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 -
      "Systems and Equipment" and Section 7 - "Construction and Startup."

2.2 COILS
   A. Manufacturers:
      1. Retain "Basis-of-Design Product" Paragraph and list of manufacturers below to identify a
         specific product or a comparable product from manufacturers listed. Retain option and
         delete insert note if manufacturer's name and model number are indicated on Drawings.
2. By air handling unit manufacturer.

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 0.020 inch thick.

F. Fins: Copper 0.008 inch thick.

G. Headers: Cast iron with cleaning plugs and drain and air vent tappings or Seamless copper tube with brazed joints, prime coated.

H. Frames: 304 Stainless steel with slip-in or flanged mounting.


PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install coils level and plumb.

B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Install stainless-steel drain pan under each cooling coil.

1. Construct drain pans with connection for drain; insulated and complying with ASHRAE 62.1.

2. Construct drain pans to extend beyond coil length and width and to connect to condensate trap and drainage.

3. Extend drain pan upstream and downstream from coil face.

4. Extend drain pan under coil headers and exposed supply piping.

5. Construct drain pan of 16 gauge, 304 stainless steel with all welded seams and joints.

D. Install moisture eliminators for cooling coils. Extend drain pan under moisture eliminator.
E. Straighten bent fins on air coils.

F. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

A. 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 230900 "Instrumentation and Control for HVAC," and other piping specialties are specified in Section 232116 "Hydronic Piping Specialties."

END OF SECTION 23 82 16
SECTION 23 99 99
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. Cerus
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. For specific enclosure ratings see drawing equipment schedules.

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, pad-lockable 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 acknowledge 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 23 99 99
DIVISIONS 24 – 25
NOT USED
DIVISION 26
ELECTRICAL
SECTION 26 00 10
ELECTRICAL GENERAL REQUIREMENTS

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.

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.

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.

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.

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. Reinforce with 6” x 6” W2.9 x W2.9, 10GA (3.4mm) mesh, with short dowels into floor at 12” OC around perimeter.

   D. Chamfer top edges ¾” (18mm).

   E. Make all faces smooth.

   F. Set anchor bolts for equipment. Consult with user.

   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 16. 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 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
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. 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 “Through-Penetration Firestop Systems.”

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. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of 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 "Through-Penetration Firestop Systems."

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 07 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 07 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 07 Section "Through-Penetration Firestop Systems."

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
SECTION 26 05 10
ELECTRICAL EQUIPMENT ACCEPTANCE TESTING

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 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.

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.

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.

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):

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.
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.

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 as 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 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 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.
SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. 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 (90°C). Color code as specified herein shall not be required for fixture wire; however, neutral
Conductor shall be identified distinctly from phase conductors. Conductors connected to vapor tight fixtures shall be type AF.

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 manufacturers 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 shall be kept to the minimum practicable and shall only be made as necessary to support pulling of the conductors. Make 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, ¾” diameter, minimum length – 10’.
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.

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
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 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
SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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, 1-1/2" 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 Industries, or equal. Vibration isolator shall be consistent with that tested and approved by OSP.

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 surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch off wall, or on ¾” plywood backboards.

G. Install plywood backboards over gypsum board or directly to stud framing as indicated. Fasten to studs with self-tapping screws according to APA recommendations.

H. 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.

I. 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.

J. 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.

K. 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
SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

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. Thomas and Betts
   c. or equal

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 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 14 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 ½" rod for individual conduits 2.0" and larger. 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 ¾” 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 ¾” 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.

C. Fire and smoke stop materials shall be UL rated to maintain the fire floor or fire wall partition rating.

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 the 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.

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 bolts or beam clamps to steel, and post-installed anchors to concrete, as denoted on drawings.

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 used for connection of motor, dry type transformers, electric duct heaters, and unit heaters, shall not exceed 18" in length.

Flexible conduit from outlet box to flush mounted lighting fixture shall not exceed 6 feet in length.

Maintain ground continuity through flexible conduit with green equipment grounding conductor; do not use flexible conduit for ground continuity.

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 1½” 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 yellow, 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 02 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 plastic identification 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 \( a \) 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.

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.

8. Install all conduits or sleeves penetrating rated fire walls or fire floors to maintain fire rating of wall or floor.

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 2–½" 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.
SECTION 26 05 43
UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. 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:
a. Armorcast Products Company.
b. Carson Industries LLC.
c. CDR Systems Corporation.
d. NewBasis.

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. Christy Concrete Products.
      d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.

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 in 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 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. The NUSIG / Badger Industries, OSHPD pre-approval OPA-0215 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 NUSIG /Badger Industries, OSHPD pre-approved service loads, installation applications, engineering services, etc. Furthermore, said other OSHPD pre-approved designs must be submitted to the designers or 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 born 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. Applications not covered by the NUSIG / Badger Industries OSHPD pre-approval No. OPA-0215 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).

   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 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>
<thead>
<tr>
<th>CONDUIT PLUS CONTENTS WEIGHT DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMT SIZE (IN)</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>½</td>
</tr>
<tr>
<td>¾</td>
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<tr>
<td>1</td>
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<td>1–¼</td>
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<td>2–½</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>3–½</td>
</tr>
<tr>
<td>4</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 2–½” conduit plus contents, use 320 LB criteria or submit alternate details for approval.

21. All single conduits 2–½” 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 1.1.D 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 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.

END OF SECTION 26 05 48
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. Brady, W.H. Company
2. Panduit Corporation
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 1-1/2" wide.
      a. Colors: Unless otherwise indicated or required by governing regulations, provide orange tape.

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 3-1/4" x 5-3/4", 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: 3/16", 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 white 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 purposed. 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

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IDENTIFICATION FOR ELECTRICAL SYSTEMS
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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.

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:

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
SECTION 26 05 74
ARC-FLASH LABELS

PART 1 - GENERAL

1.01 DESCRIPTION

A. GENERAL:

1. This section specifies that the Contractor will provide arc-flash labels for electrical power panels included in the project scope. The arc-flash labels message or content shall be provided to the Contractor by the University.

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. 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).

B. 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 PHOTOLELECTRIC 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 phototransistors 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 dis-
connect, 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 fol-
   lowing:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indi-
   cated 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 man-
   ual 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 Con-
   ductors 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 in-
   diated. 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.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 09 23
SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
   1. Distribution transformers.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 26 Section "Seismic Control - OSHPD." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Qualification Data: For testing agency.

C. Source quality-control test reports.

D. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE
A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

D. 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.

E. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

F. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting NEMA TP 1, Class 1 efficiency levels when tested according to NEMA TP 2.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.8 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. General Electric Company
   2. Square D; Schneider Electric
   3. Or equal.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.
   1. Internal Coil Connections: Brazed or pressure type.
   2. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.
   1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250.
   1. Finish Color: Gray.

F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 80 deg C rise above 40 deg C ambient temperature.

H. Energy Efficiency for Transformers Rated 15 kVA and Larger:
   1. Complying with NEMA TP 1, Class 1 efficiency levels.
   2. Transformers shall be low loss type with minimum efficiencies per NEMA TP1 when operated at 35% of full load capacity. Efficiency shall be tested in accord with NEMA TP2.

<table>
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<th>Three Phase</th>
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<td>98.9%</td>
</tr>
<tr>
<td>750</td>
<td>98.8%</td>
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</table>

I. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
   1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

J. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
   1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
   2. Include special terminal for grounding the shield.
   3. Shield Effectiveness:
      a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
      b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
      c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

K. Wall Brackets: Where indicated on drawings, manufacturer's standard brackets with anchorage meeting seismic requirements.

L. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
   1. Brace wall-mounting transformers as specified in Division 26 Section "Seismic
Control - OSHPD."

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 26 Section "Hangers and Supports for Electrical Systems."

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Infrared Scanning: During Level 4 commissioning when facility load is simulated with load banks, perform an infrared scan of transformer connections.
   1. Use a video camera infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
   2. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 00
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Lighting and appliance panelboards shall be rated 1200A or less.
   2. Distribution panelboards shall be rated 1200A or less.

1.2 SUBMITTALS

A. Shop Drawings: Submit in accordance with Division 01. Include all physical dimensions, gutter space, physical construction, and list the following information:
   1. Panel designation
   2. Voltage rating
   3. Current rating
   4. Top, bottom or through feed lugs, lug size
   5. Main overcurrent device size.
   6. Branch device schedule, listing size and poles
   7. Surface trim or recessed.
   8. Fault current rating of the panel and devices
   10. Bus material.
   11. Indicate any special requirements including key locking, split bus, contactor panels, double panels, or panels in special NEMA enclosures.
   12. Indicate which panelboards are electronic grade.

B. Operation and Maintenance Manuals: Submit in accordance with Division 01, in the following format.
   1. Provide an 8-½” x 11” typewritten panel schedule for each panel, protected by a mylar jacket, and bound in a three ring binder.
   2. Schedules shall include:
      a. Panel designation.
      b. Panel location.
      c. Voltage, phase, current rating.
      d. Main overcurrent device size.
      e. Branch circuit listing indications circuit number and description of loads served.
      f. Source of panel feeder.
   3. Panel schedule book shall be assembled based on “As Built” information, and submitted to the University upon completion of the project. Provide one hard copy of book and provide one CD or Zip-disk containing updated panel schedules in MS Excel format.

1.3 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA).

B. American National Standards Institute (ANSI).
1.4 QUALITY ASSURANCE

A. Manufacturer shall have specialized in the manufacture and assembly of lighting and appliance panelboards for 50 years.

B. Panelboards shall be listed and/or classified by Underwriters Laboratories in accordance with standards listed in Article 1.3 of this specification.

C. Panelboards shall be qualified for use in seismic areas as follows:
   1. High seismic loading as defined in IEEE Std 693-2005, with 2.0 amplification factors.
   2. IBC-2009, Sds = 1.81g, Ss = 2.72g, Ip = 1.5, for z/h equal to 1 and Sds = 2.90g, Ss = 4.35, Ip = 1.5, for z/h equal to 0 in accordance with ICC-ES-AC156.
   3. Seismic compliance shall be qualified only through shake table testing. Compliance by calculation is not acceptable.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General Electric, Spectra and A Series

B. Square D

C. Or equal

2.2 PANELBOARDS - GENERAL CONSTRUCTION

A. Backbox: Code gauge galvanized steel, minimum 20" wide and 5-3/4" deep, unless otherwise indicated or required. Provide gutter space in accordance with code, including additional space where required for feeder cable installations. Corners shall be lapped and riveted.

B. Interior: Provide the number of overcurrent devices and spaces as indicated on the plans and in the Panelboard Schedule. Panel bus bars shall be copper only and shall be aligned and rigidly supported on the back pan by insulators connected to a removable mounting panel. Lugs shall be sized for the wire indicated on the plan. Full length vertical buses and cross overcurrent device connection, including all hardware, shall be provided and installed for all spaces. When buss bars are not factory tapped, (all) breaker hardware must be factory mounted.

C. Neutral Bus: Double capacity of the phase bus with lugs and terminals for terminating the sizes and quantity of neutral conductors indicated and required.

D. Ground Bus: 50% capacity of the phase bus with lugs and terminals for terminating the sizes and quantity of ground conductors indicated and required.

E. Where indicated on the drawings provide isolated ground bus.

F. Trim: Cabinet front with concealed trim clamps and flush lock all keyed alike. Trim shall be dead front with metal frame index holder on inside of door. Panelboard enclosures shall be provided with either a flush or surface trim as indicated in the Panelboard Schedule, or shown on the plan. Trim shall be painted baked on ANSI #61, light gray enamel. Covers shall be hinged so that they swing away to provide full access to the
interior of the panel without removing the cover. Covers designed for more than one panel section shall not be permitted. Hinged type door covering all circuit breakers shall be included in all panel trims.

G. Panelboard Rating:
1. Voltage and ampere rating as indicated in the Panelboard Schedule or plans.
2. Integrated or series rated devices shall not be used to meet the specified fault current levels.
3. Provide service entrance rated and labeled panelboards where required for the application.
4. Circuit breakers shall have 80% continuous rating unless indicated otherwise and shall not have continuous loads that exceeds 80% of the continuous rating. Provide 100% rated circuit breakers only where required by code or where indicated.

2.3 PANELBOARDS – 120/208-VOLT

A. Branch Circuit Panelboards:
1. Panelboards shall be bolt-on circuit breaker type with the short circuit interrupting ratings required for the available fault current.
2. Panelboards, main circuit breakers, and subpanel feeder circuit breakers shall be rated less than 400A and shall have a continuous rating of 80%.
3. Minimum fully rated Short Circuit Rating: 10,000-amperes rms or as shown on Drawings.
4. Branch circuit breakers shall be molded case, thermal magnetic trip type with common trip handle for all poles.
5. Branch circuit breakers shall have a maximum rating of 100-ampers. 15-ampere through 100-ampere trip size shall fit in the same pole spacing.

B. Distribution Panelboards:
1. Panelboards shall be bolt-on circuit breaker type with the short circuit interrupting ratings required for the available fault current.
2. Panelboards shall have a continuous rating or setting of 400A to 1200A. Circuit breakers shall have frame ratings of 150A to 1200A. Circuit breakers shall have continuous ratings of 80% unless a 100% continuous rating is indicated or required by code.
3. Minimum fully rated Short Circuit Rating: 18,000-amperes rms, or as shown on Drawings.
4. Circuit breakers shall be electronic grade with field adjustable continuous load ratings. Instantaneous trip settings shall also be field adjustable.
5. Circuit breakers shall be a minimum of 150 ampere frame.
6. Circuit breakers shall be a minimum of 100-ampere frame. 15-ampere through 100-ampere trip size shall fit in the same pole spacing.

C. Provide a suitable circuit breaker, sized for the load, for each branch circuit shown on the plans, if not identified or noted in the Panelboard Schedule.

2.4 PANELBOARDS – 277/480-VOLT

A. Branch Circuit Panelboards:
1. Panelboards shall be bolt-on circuit breaker type with the short circuit interrupting ratings required for the available fault current.
2. Minimum fully rated Short Circuit Rating: 14,000-amperes rms, or as shown on Drawings.
3. Panelboards, main circuit breakers, and subpanel feeder circuit breakers shall be rated less then 400A and shall have a continuous rating of 80%.
4. Branch circuit breakers shall be molded case, thermal magnetic trip type with common trip handle for all poles.
5. Branch circuit breakers shall have a maximum rating of 100-amperes. 15-ampere through 100-amperes trip size shall fit in the same pole spacing.

B. Distribution Panel boards:
1. Panel boards shall be bolt-on circuit breaker type with the short circuit interrupting ratings required for the available fault current.
2. Minimum fully rated Short Circuit Rating: 42,000-amperes rms, or as shown on Drawings.
3. Panelboards and circuit breakers shall have a continuous rating or setting of 400A to 1200A and shall have a continuous rating of 100% where indicated on drawings.
4. Circuit breakers shall be electronic grade with field adjustable continuous load ratings. Instantaneous trip settings shall also be field adjustable.
5. Circuit breakers shall be minimum of 150 ampere frame.

C. Provide a suitable circuit breaker, sized for the load, for each branch circuit shown on the plans, if not identified or noted in the Panelboard Schedule.

PART 3 EXECUTION

3.1 INSTALLATION

A. Mount panelboards securely to the building structure. Panelboards surface mounted on steel stud and gypsum board walls shall be mounted to channel, bridging two or more studs. Installation shall comply with all applicable seismic requirements.

B. Provide spacers where panelboards are surface mounted on outside walls, to space the panel 1-½" from the wall.

C. Connect circuits shown on the plans for a balanced 3-phase load.

D. Install panelboards in conformance with NEMA PB 1.1 and manufacturer's installation instructions. Maximum mounting height - 6'-6" to top of panelboard. Panels weighing 20 pounds or more shall be installed per details on the drawings, in accordance with the CBC.

E. Stub (2) spare one inch conduits to accessible location above ceiling out of each recessed panelboard.

F. Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of all electrical connections.

3.2 IDENTIFICATION

A. Provide labeling as specified in Division 26 “Identification for Electrical Systems”.

B. Provide a typewritten index of circuits inside the door of the panelboard. Type directing to indicate actual field installation, with odd numbering on left and even numbering on right.
C. Provide identification of ungrounded conductors according to the CEC at each branch circuit panelboard. Install permanent typewritten index similar to index of circuits.

3.3 TESTING AND ADJUSTMENT

A. Perform the short-circuit test on the overcurrent devices by simultaneously connecting the fault to each panelboard overcurrent device with the panelboard connected to its rated voltage source.

B. Method of testing per UL Standard 67.
   1. Test data showing the completion of such tests furnished to the University's Representative before the submittal of approval drawings.
   2. Testing of panelboard overcurrent devices for short-circuit rating only with the overcurrent devices individually mounted is not acceptable.
   3. Adjust all variable trip circuit breakers to the proper setting for the load each circuit breaker is protecting. Retest to verify the setting is correct and make adjustments as needed. After the settings are completed, record the panel number, device number with the load trip point that the device has been adjusted for and the name and size of the load on a typed separate sheet of paper. Place one copy of this paper in the panel directory pocket and provide one copy with each operations and maintenance manual.

3.4 INSPECTION

A. Examine area to receive panelboards to assure adequate clearance for installation.

B. Check that walls are proper thickness for recessed panels.

C. Start work only after any unsatisfactory conditions are corrected.

END OF SECTION 26 24 16
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/ Wires</th>
<th>Volts</th>
<th>Amps</th>
<th>Configuration</th>
<th>Cat. No.</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>2P-3W</td>
<td>125</td>
<td>20</td>
<td>5-20R</td>
<td>8300</td>
<td>General Duplex</td>
</tr>
<tr>
<td>2P-3W</td>
<td>125</td>
<td>20</td>
<td>5-20R</td>
<td>8898-HG</td>
<td>General GFI Duplex</td>
</tr>
<tr>
<td>2P-3W</td>
<td>125</td>
<td>30</td>
<td>5-30R</td>
<td>5371</td>
<td>Equipment Single</td>
</tr>
<tr>
<td>2P-3W</td>
<td>250</td>
<td>20</td>
<td>6-20R</td>
<td>5461</td>
<td>Equipment Single</td>
</tr>
<tr>
<td>2P-3W</td>
<td>250</td>
<td>30</td>
<td>6-30R</td>
<td>5372</td>
<td>Equipment Single</td>
</tr>
<tr>
<td>2P-3W</td>
<td>125</td>
<td>20</td>
<td>5-20R</td>
<td>P&amp; S. TR62-H</td>
<td>Tamper Resistant</td>
</tr>
</tbody>
</table>
| 2P-3W       | 125   | 20   | 5-20R        | 8300-IGIsolated | Ground Ground

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 ¼" 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
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.
d. Fuse size for elevator feeder and disconnect applications.

2. Maintenance data for tripping devices to include in the "Operating and Maintenance Manual" specified in Division 01.

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
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.

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:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

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:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

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:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

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:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

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 "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

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:
   4. 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.
   5. 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.
   6. 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.
7. 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.

END OF SECTION 26 28 16
PART I - GENERAL

1.01 SUMMARY

A. Section Includes

1. Light Fixtures
2. Lamps
3. Ballasts
4. Egress and Exit Signs
5. Mounting and Installation Hardware
6. Fixture Allowances
7. Utility Rebates
8. Disposal of PCB Ballasts and Lamps Containing Mercury

1.02 SUBMITTALS

A. Prior Approvals: Submit the following:

1. Manufacturer’s data required to evaluate the product for which approval is sought including, photometric data with specified options, dimensional data, weight, and catalog cut sheets.

2. A letter indicating differences between each product specified and the product for which approval is sought, including overall and aperture dimensional data, specified options available, mounting information, finishes and photometric data.

3. Submittals which do not contain the above information will not be considered.

B. Shop Drawings: Submit in accordance with Division 1, including the following.

1. Dimensional Drawing/Material/Finish
2. Weight
3. Options provided
4. Voltage
5. Photometric and Performance Data
6. Ballast manufacturer and model number
7. Lamp manufacturer and ANSI Code
8. Mounting hardware
9. Components that are non-standard
10. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under "Regulatory Requirements".
11. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

C. Provide lighting shop drawings in one submittal. Include required information for all fixtures, lamps, ballasts, and mounting hardware in shop drawing submittal. Incomplete submittals will be returned to the Contractor without being reviewed.

D. Samples.
   1. Submit a sample to the University's Representative for review when indicated on the Light Fixture Schedule or when a fixture is discontinued or otherwise requires substitution and approval after bids have been received.
      a. Submit a shop drawing, and letter stating whether the fixture is one from a standard factory run or a special assembly and arrange for the manufacturer's representative to meet with the University's Representative to facilitate the approval process at the same time as the submittal of the sample.
      b. Samples will be held by the University's Representative until completion of the approval process and then returned to the Contractor or his designee.

E. Submit quantity invoices for all lamps and ballasts which qualify for energy rebates in accordance with Section 01700 (Contract closeout).

F. Submit disposal/recycling manifests for all lamps containing mercury and ballasts containing polychlorinated biphenyl (PCB) indicating disposal method as outlined below in accordance with Division 01 (Contract closeout).

1.03 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01.

B. Accurately record actual locations of each luminaire.
1.04 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01.

B. Maintenance Data: Include replacement parts list.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.06 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.07 REFERENCE STANDARDS

A. Underwriter's Laboratories (UL).

B. American National Standards Institute (ANSI).

C. National Electrical Manufacturers Association (NEMA).

D. Illuminating Engineering Society of North America (IESNA).

E. National Fire Protection Association (NFPA 70).

PART II - PRODUCTS

2.01 LIGHT FIXTURES - GENERAL

A. Acceptable Manufacturers.

   1. As specified in the Light Fixture Schedule see Appendix A

B. Written description in the specification or in the Light Fixture Schedule indicates the desired fixture options and overrides the manufacturer’s catalog numbers given.

C. Provide all light fixtures complete with lamps, ballasts, and accessories required as shown on the Drawings and written schedule.

D. Provide light fixtures UL listed for through wiring with junction boxes accessible from the fixture frame-out opening for recessed fixtures installed in inaccessible ceilings.

E. Provide fixtures designed, tested and guaranteed by the manufacturer for ballast coil temperature not to exceed 90°C for the particular application being used.

F. Provide fixtures designed and/or gasketed to prevent light leaks from around lenses, trims and/or frames.
G. Provide lenses that are 100% virgin acrylic, .156” thick nominal, Pattern 19, unless noted otherwise in the Light Fixture Schedule.

H. Provide downlights with clear alzak cones and self flange trims unless noted otherwise on the Drawings

I. Provide parabolic aluminum louvers or cones designed to eliminate or provide very low iridescence when used with tri-phosphor lamps.

J. Where threaded fasteners are used for latching frames provide fasteners designed to be captive into the frames.

K. Provide and coordinate the fixture mounting accessories for all ceiling types and check ceiling finishes, clearances, structure suspension system, etc., before placing fixture orders to insure correct application. Provide fixtures with grid trim appropriate for acoustical ceiling suspension systems specified in Division 09. Refer to architectural reflected ceiling plans and details. Coordinate with ceiling type provided by the General Contractor.

L. Provide Fluorescent troffer fixtures:
   1. Constructed of a minimum of 22-gauge steel for chassis, wiring channel, and end plates.
   2. With end plates connected to chassis with fasteners or by welding. Slot and tab connections are not be acceptable.
   3. With steel housings that have been chemically treated, then finished in high temperature polyester powder coating with reflectance of at least 85%. Provide housings painted after fabrication.
   4. With ballasts factory wired for inner and outer lamp switching on fixtures with 3 or more lamps, unless noted otherwise.
   5. With aluminum lens frames with mitered corners and cam style frame latches.
   6. With tombstone turret design lamp sockets.

M. Exterior Fixtures
   1. Provide exterior fixtures with clear tempered glass lenses unless indicated otherwise in Light Fixture Schedule.
   2. Provide a minimum 2.5 mil thick baked on polyester powder finish, color as specified in the Light Fixture Schedule for exterior fixture housing and poles.
   3. Provide fully gasketed, exterior fixture lens and diffuser frames to prevent moisture, debris, and insects from entering the fixture housing.
   4. Provide ballasts rated to start at -20°F.
2.02 LAMPS

A. Acceptable Manufacturers: The following lamp manufacturers are acceptable for lamps specified. Provide all lamps of a given type (Fluorescent, Incandescent, or HID) from one manufacturer except where the Light Fixture Schedule indicates the specific manufacturer.

B. Incandescent & Halogen Lamp Manufacturers:
   1. General Electric
   2. Osram Sylvania
   3. Philips
   4. or equal.

C. MR-16 lamps IR technology Osram Sylvania, Philips or equal unless otherwise specified.

D. Fluorescent Lamp Manufacturers:
   1. General Electric
   2. Osram Sylvania
   3. Philips
   4. or equal.

E. High Intensity Discharge (HID) Lamp Manufacturers:
   1. Venture
   2. General Electric
   3. Osram Sylvania
   4. Philips
   5. or equal.

F. Provide lamp type specified for luminaire.

G. Reflector Lamp Beam Patterns: ANSI C78.379.

H. Provide fluorescent lamps of wattages, styles, and lengths as described in the Light Fixture Schedule with a color temperature of 3500K and CRI greater than 80, unless otherwise specified.

I. Provide 4-pin compact fluorescent lamps in fixtures with dimming ballasts.

J. In open fixtures metal halide fixtures provide metal halide lamps which automatically extinguish when the outer envelope is broken or punctured. Provide this feature regardless of the lamp ordering code listed in the Light Fixture Schedule.
2.03 BALLASTS

A. General requirements.

1. Provide ballast suitable for lamps specified.
3. Ballast must operate between 108V-132V for 120V operation or between 249-305V for 277V operation.
4. Ballast shall be greater than or equal to 0.90 Power Factor.
5. Ballast shall have an “A” sound rating or the quietest rating for a particular ballast class.
6. Ballasts shall maintain light regulation of ±10% with ±10% input voltage variation.
7. Ballast shall have a 3-year manufacturers warranty, including a $10 per ballast labor allowance.
8. Lamp current crest factor shall not exceed 1.7.
9. Ballast shall meet ANSI C82.11 limits for Total Harmonic Distortion (THD).
10. All ballasts shall have a maximum lead length from ballast to lamp socket less than or equal to the manufacturer’s recommendation.
11. Ballast shall provide transient immunity as specified in ANSI C62.41.
12. Ballast shall be provided with integral leads, color-coded to ANSI standard C82.11.
13. All fluorescent T4, T5, T5HO & electronic HID ballasts must contain a lamp end-of-life protection and shut down in accordance with ANSI/IEC proposed standards.

B. Fluorescent ballasts.

1. General requirements.

  a. Description: ANSI C82.1, high power factor, electronic ballast, Class P thermally protected, unless otherwise specified.
  b. Ballast factor shall have a power factor of not less than 0.95.
  c. Ballasts shall have a total harmonic current distortion (THD) of less than 10% at maximum light output.
  d. Ballast output frequency shall be greater than 40kHz to avoid interference with infrared control systems, and eliminate visible flicker.
e. Ballast must be able to start and operate the specified lamps at a minimum temperature of -20°F for exterior applications and 0°F for interior applications as indicated on the datasheet and shall be in accordance with lamp manufacturer’s recommendations.

2. General dimming ballast requirements.
   a. Where dimming controls are used, dimmable ballasts and lighting control systems shall be from the same manufacturer.
   b. Dimming shall control lamp light output ranging from 5%-100%.
   c. Dimming ballasts shall be capable of striking lamps at any light level without first flashing to full light.
   d. Ballasts shall have a power factor greater than 0.90 for the entire dimming range.
   e. Electronic ballast shall not be damaged by mis-wiring line voltage and control wire leads or any output lead to another output lead.
   f. THD at minimum light output shall not exceed THD at maximum light output.
   g. Ballast shall have been on the commercial market for a minimum of 2 years.
   h. Ballasts shall be program start.

3. Ballasts for Compact Fluorescent Lamps (CFL) with fixed light output:
   a. Osram Sylvania, Quicktronic CF
   b. Advance, VH-1B or VH-1Q Series, or equal.

4. Ballasts for T8 Fluorescent Lamps with fixed light output:
   a. Osram Sylvania, Quicktronic PSN
   b. Advance, VIC (or RIC) S32
   c. or equal.
   d. Ballast shall be program start, programmed rapid start or rapid start.
   e. Ballast shall be program start when controlled by occupancy sensors.

5. Ballasts for T5 Fluorescent Lamps with fixed light output:
   a. Osram Sylvania, Quicktronic PS
   b. Advance, VCN (or RCN) S28
c. or equal.

d. Ballast shall have been on the commercial market for a minimum of 1 year.

6. Ballasts for Fluorescent T5HO Lamps with fixed light output:
   a. Osram Sylvania, Quicktronic PHO
   b. Advance, ICN
   c. or equal.
   d. Ballasts shall be program start.

7. Ballasts for fluorescent dimming:
   a. Lutron, ECO-10 (on Grafik Eye 3000 systems) Hi-Lume (on Grafik Eye 4000 systems) Advanced Mark X (0-10V)
   b. or equal.

2.04 HIGH INTENSITY DISCHARGE BALLASTS (HID: Magnetic core & coil)

A. Acceptable Manufacturers
   1. Advance.
   2. Venture.
   3. Universal.
   4. Valmont.

B. Provide premium constant wattage, autotransformer, power factor greater than 90%, potted core and coil type. Equip ballasts with individual fuses.

C. Provide for interior use suitable for application with room ambient noise level of 35NC without additive noise contribution to exceed the noise curve criteria. Verify proper ballast application and mounting to insure acceptable operation for the application specified.

D. Ballasts shall be designed in accordance with ANSI C82.4 and applicable ANSI specifications.

E. The core & coil ballast shall be designed with class "H" (180°C) or higher insulation system.
F. Ignitors for High Intensity Discharge Ballasts.
   1. Remote ballasts shall have properly sized ignitor as required for pulse start lamp specified.

G. Provide a one year guarantee against defects in workmanship or material which includes an in-warranty service program providing for the payment of authorized labor charges incurred in the replacement of defective in-warranty ballasts.

2.05 HIGH INTENSITY DISCHARGE BALLASTS (HID: ELECTRONIC)

A. Acceptable Manufacturers
   1. Aromat
   2. or equal.

2.06 EXIT LIGHTS / EXIT SIGNS

A. Acceptable Manufacturers:
   1. As specified in the Light Fixture Schedule.

B. Provide cast aluminum stencil face Exit Signs with fully concealed chevron type directional arrow knockouts and universal mount canopy unless indicated otherwise on the Drawings.

C. Provide exit lights illuminated from light emitting diodes (LED) designed so that individual LEDs cannot be seen when the exit light is installed and illuminated.

D. Provide canopy, housing, stencil face and flange trim with white high temperature or polyester powder coat painted finish.

E. Letters shall be Red.

F. Do not install exit signs that utilize radioactive Tritium (³H) gas to provide illumination.

PART III - EXECUTION

3.01 DEMOLITION

A. Properly dispose of lamps containing mercury and ballasts containing PCB or not marked "NO-PCB by Recycling".

B. Acceptable Recyclers:
   1. Recyclites: Bloomington, MN
   2. Full Circle Ballast Recyclers: New Jersey
   3. Others as approved.
3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install suspended exit signs using stem pendants from swivel hangers.

C. Install suspended luminaires using stem pendants from swivel hangers, aircraft cable, and chain in accordance with the intended design. Provide stem pendants, aircraft cable, and chain lengths required to suspend luminaire at indicated height.

D. Support luminaire larger than 2’ x 4’ size, or heavier than 56 pounds independent of ceiling framing.

E. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.

F. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

G. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure.

H. Install recessed luminaires to permit removal from below.

I. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

J. Install clips to secure recessed grid-supported luminaires in place.

K. Install wall mounted luminaires and exit signs at height as indicated on Drawings.

L. Install accessories furnished with each luminaire.

M. Connect luminaires and exit signs to branch circuit outlets using flexible conduit as required.

N. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

O. Bond products and metal accessories to branch circuit equipment grounding conductor.

P. Install specified lamps in each luminaire.

3.03 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connections and operation.

3.04 ADJUSTING

A. Adjust Work under provisions of Division 01.

B. Aim and adjust luminaries as indicated on drawings.
C. Provide materials and labor for aiming and adjusting lighting fixtures under Architects supervision. Aiming and adjusting shall take place immediately before building is turned over to Owner.

D. Adjust exit sign directional arrows as indicated.

E. Relamp luminaires that have failed lamps at Substantial Completion.

F. Provide all new lamps burned in for 100hrs.

3.05 CLEANING

A. Clean Work under provisions of Division 01.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosure.

D. Clean photometric control surfaces as recommended by manufacturer.

E. Clean finishes and touch up damage.

3.06 DEMONSTRATION

A. Provide systems demonstration under provisions of Division 01.

B. Provide minimum of two hours demonstration of luminaire operation.

C. Install continuous row fixtures as shown on drawings. The fixture type letter next to one fixture identifies all fixtures in the row. Rows are made up of either 4’ or 8’ long lamps in combination to complete the row. Catalog numbers listed on the light fixture schedule for fluorescent fixture type are for a basic 4’ long fixture unless noted otherwise on the Drawings. Contractor shall be responsible for quantities of fixtures required in any row and for supplying fixtures which are an interior continuous mounting or a fixture with end cap. The channels or fixtures may be longer than 4’, but all plastic lenses, hinged doors and louver sections shall not exceed four feet long.

D. Install concrete bases for exterior fixtures except parking lot fixtures with top of base flush with finished grade or as detailed on the Drawings. Install concrete bases for parking lot fixtures a minimum of 30” above paving to top of base or as detailed on the Drawings.

E. Clean fixtures immediately before the final inspection. Provide fixtures newly lamped and in perfect operating condition at the completion of the job. Replace Metal halide lamps which show a visible color shift after 100 hours of operation.

3.07 ENERGY REBATES

A. Submit quantity invoices for all lamps and ballasts which qualify for energy rebates.

B. Apply for all applicable lamp and ballast energy rebates.

C. Retain samples of existing lamps and ballasts as proof of energy savings when required by the energy utility for rebate.
D. Coordinate with the electrical utility to facilitate rebate payments to be made directly to the Owner.

END OF SECTION 26 50 00
SECTION 26 51 10.01
LIGHTING FIXTURES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Lighting Fixtures
2. Lamps
3. Ballasts
4. Egress and Exit signs
5. Mounting and Installation Hardware
6. Fixture Allowances
7. Utility Rebates

1.02 SUBMITTALS

A. Prior Approvals: Submit the following:

1. Manufacturer's data required to evaluate the product for which approval is sought including, photometric data with specified options, dimensional data, weight, and catalog cut sheets.

2. A letter indicating differences between each product specified per 01 61 00 and the product for which approval is sought, including overall and aperture dimensional data, specified options available, mounting information, finishes and photometric data.

3. Submittals which do not contain the above information will not be considered

B. Shop Drawings: Include the following:

1. Dimensional Drawing/Material/Finish
2. Weight
3. Options provided
4. Voltage
5. Photometric and Performance Data
6. Ballast manufacturer and model number
7. Lamp manufacturer and ANSI Code
8. Mounting hardware

9. Components that are non-standard

10. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under “Regulatory Requirements”.

11. Manufacturer’s Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

C. Provide lighting shop drawings in one submittal. Include required information for all fixtures, lamps, ballasts, and mounting hardware in shop drawing submittal. Incomplete submittals will be returned to the Design–Builder without being reviewed.

D. Samples:

1. Submit a sample to the University’s Representative for review when indicated on the Light Fixture Schedule or when a fixture is discontinued or otherwise requires substitution and approval after bids have been received.

   a. Submit a shop drawing, and letter stating whether the fixture is one from a standard factory run or a special assembly and arrange for the manufacturer’s representative to meet with the University’s Representative to facilitate the approval process at the same time as the submittal of the sample.

   b. Samples will be held by the University’s Representative until completion of the approval process and then returned to the Design–Builder or his designee.

E. Submit quantity invoices for all lamps and ballasts which qualify for energy rebates in accordance with Division 1 Contract Closeout.

1.03 MOCKUPS

A. Where required in the contract documents, provide a mock-up of the lighting systems. The mock-up shall be erected in a time period and location that is acceptable to the Architect. The contractor shall assume that the mock-up will be off the project site but within a 30 mile radius of the project. Include the following types in the mock-up.

B. The mock-up installation shall closely conform with the conditions of the actual installation as to: height, distance from the soffit, ground or wall, number and type of lamps, materials, colors, etc. Submit a drawing of the mock-up condition for approval prior to commencing construction.

C. The purpose will be to study the general appearance and performance of the systems. Minor modifications may be required as a result of the mock-up to meet the specified performance criteria. These modifications and others that do not materially affect the cost of the installation, shall be incorporated at no additional cost to the owner.

1.04 PROTOTYPES

A. All custom fixtures require a prototype to be submitted prior to commencement of final fabrication. The purpose of the prototype will be to review finishes, lamp placement within the fixture, lamp type and reflector shape or size. Modifications may be required as a
result of the prototype review. These modifications and others that do not materially affect the cost of the fixture shall be incorporated at no additional cost to the owner.

1.05 EXTRA MATERIALS

A. Lamps: Provide one case or 10% (whichever is less) of each type used on the project. Turn over to Owner and obtain signed receipt.

B. Fuses: Provide one case or 10% (whichever is less) of each type used on the project. Turn over to Owner and obtain signed receipt.

1.06 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of each luminaire.

1.07 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include replacement parts list.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.09 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70

B. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.10 REFERENCES

A. 01 51 00

B. 26 00 10

C. 26 05 00

D. 26 09 23

E. National Electrical Manufacturer’s Association (NEMA) LE5−1993:
   1. Procedure for determining Luminaire efficiency ratings.

F. Underwriters Laboratories, Inc. (UL):
   1. UL 924: Emergency Lighting and Power Equipment UL 1012
   2. Power Units Other Than Class 2
   3. UL 1310 Class 2 Power Units
   4. UL 1574: Track Lighting Systems
5. UL 1598  Luminaires
6. UL 1838  Low Voltage Landscape Lighting Systems
7. UL 1994  Luminous Egress Path Marking Systems

G. American National Standards Institute (ANSI)
H. Illuminating Engineering Society of North America (IESNA)
I. National Fire Protection Association (NFPA 70)

1.11 DEFINITIONS

A. CCT: Correlated color temperature.
B. CRI: Color-rendering index.
C. LER: Luminaire efficacy rating.
D. Lumen: Unit of luminous flux. Photometrically, it is the luminous flux emitted within a unit solid angle by a point source having a uniform luminous intensity of 1 candela.
E. Luminaire: Complete lighting fixture, including ballast, lamp, housing, parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply.

1.12 SYSTEM DESCRIPTION

A. Light fixture schedule series numbers are a design series reference and do not necessarily represent the exact catalog number, size, voltage, wattage, type of lamp, ballast, finish trim, ceiling type, mounting hardware, ceiling trim or special requirements as specified hereinafter or as required by the particular installations. Provide complete fixtures to correspond with the number of lamps, wattage and/or size specified.
B. If there are discrepancies between fixture illustrations and the written description in the fixture schedule, the written description in the fixture schedule shall take precedence.
C. Light fixture voltage shall match voltage of circuit serving the light fixture.

1.13 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.
D. Comply with CEC.
E. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.14 COORDINATION
A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.15 WARRANTY
A. Exit Signs Utilizing LED Lamp Technology: Provide manufacturer’s warranty for a period of not less than five years including parts and labor for full replacement of defective product.
B. LED Luminaires: Provide manufacturer's warranty for a period of not less than three years for repair or replacement of defective electrical parts, including light source and power supplies.
C. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

2. Warranty Period for Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

PART 2 - PRODUCTS

2.01 GENERAL MATERIAL REQUIREMENTS
A. Acceptable Manufacturers:

1. As specified in the Light Fixture Schedule.
B. Written description in the specification or in the Light Fixture Schedule indicates the desired fixture options and overrides the manufacturer's catalog numbers given.
C. Provide all light fixtures complete with lamps, drivers, and accessories required as shown on the Drawings and written schedule.
D. Provide light fixtures UL listed for through wiring with junction boxes accessible from the fixture frame-out opening for recessed fixtures installed in inaccessible ceilings.
E. Provide lenses that are 100% virgin acrylic, .156” thick nominal, Pattern 19, unless noted otherwise in the Light Fixture Schedule.
F. Finish ferrous mounting hardware and accessories to prevent corrosion and discoloration to adjacent materials.
G. For vapor tight installations, painted finishes of fixtures and accessories shall be weather resistant enamel using proper primers or galvanized and bonderized epoxy, so that the entire assembly is completely corrosion resistant for the service intended. Where aluminum parts come into contact with bronze or steel parts, apply a coating material to both surfaces to prevent corrosion.

H. Fixtures shall be free of light leaks and designed to provide sufficient ventilation of lamps to provide the photometric performance required. Drivers and transformers shall be adequately vented.

I. All sheet metal work shall be free from tool marks and dents and shall have accurate angles bent as sharp as compatible with the gauges of the required metal. Intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any distortion after assembly. Finish exposed edges so no sharp or ragged edges are exposed. All miters shall be in accurate alignment with abutting intersecting members.

J. Lampholders shall hold lamps securely against normal vibrations and maintenance handling.

K. Reflector Cones:
   1. Provide minimum 45° lamp and lamp image cut-off for all vertically mounted lamps. For horizontal lamps provide minimum 33° cut-off. There shall be no visible lamp flashing in the cone.
   2. Plastic materials shall not be used for reflector cones, unless noted otherwise in the Light Fixture Schedule.
   3. Reflector cones shall not be riveted or welded to housing and shall be removable without tools. Retention devices shall not deform the cone in any manner. Trim shall be flush with finished ceiling without gaps or light leaks. Where the flange trim is separate from the cone, it shall have the same finish as the cone.
   4. Reflector cones shall be of uniform gauge, not less than 0.032-inch thick, high purity aluminum Alcoa 3002 alloy, free of spin marks or other defects.
   5. Manufacture reflector under the Alzak process. Refer to fixture schedule for cone color and specular or diffuse finish requirements. For fixtures using compact fluorescent lamps, provide additional finish equivalent to Color–Chek that eliminates iridescence. Submit one sample of each cone type for review when required in the fixture schedule.

L. Fresnel Lens and Door Assembly:
   1. Lens shall have uniform brightness throughout the entire visible area at angles from 45° to 90° from vertical, without bright spots or striations.
   2. Lens shall have opaque risers painted neutral gray unless otherwise specified in the Light Fixture Schedule.
   3. Finish of regress door shall be matte baked enamel paint in color as selected by the Architect.

M. Light fixtures containing lamps which require protective shielding shall have tempered glass lenses.
N. For adjustable fixtures, provide positive locking devices to fix aiming angle. Fixture shall be capable of being relamped without adjusting aiming angle.

O. Fixtures recessed in suspended ceilings where the space above the ceiling is either an air supply or return plenum shall conform to NEC Article 300.22.

P. Safety: Provide safety devices for removable fixture elements (cones, reflectors, lenses, etc.) to support removable elements when not in normal operating position. Safety devices shall be detachable if necessary and shall not interfere with fixture performance, maintenance or the seating of any fixture element, and not be visible during normal fixture operation.

Q. Exterior Fixtures
   1. Provide exterior fixtures with clear tempered glass lenses unless indicated otherwise in Light Fixture Schedule.
   2. Provide a minimum 2.5 mil thick baked on polyester powder finish, color as specified in the Light Fixture Schedule for exterior fixture housing and poles.
   3. Provide fully gasketed, exterior fixture lens and diffuser frames to prevent moisture, debris, and insects from entering the fixture housing.
   4. Painted surfaces shall have an outdoor life expectancy of not less than 20 years without any visible rust or corrosion.
   5. Finishes to comply with requirements set by the American Architectural Manufacturers Association (AAMA):
      a. Baked on enamel and high performance powder coating finish on aluminum:
      b. AAMA 304–05
      c. Anodized aluminum: AAMA 611–98
      d. Clear coat on aluminum: AAMA 612–02
   6. Finish colors shall be as specified.

2.02 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS
   A. Comply with UL 773 or UL 773A.
   B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15–second minimum time delay. Relay shall have directional lens in front of photocell to prevent electric light sources from causing false turnoff.
      1. Relay with locking–type receptacle shall comply with ANSI C136.10.
      2. Adjustable window slide for adjusting on–off set points.
2.03 LAMPS:

A. Acceptable Manufacturers: Cree, Philips, Nichia. Provide all lamps of a given type from one manufacturer except where the Light Fixture Schedule indicates the specific manufacturer.

2.04 LIGHT EMITTING DIODE (LED) FIXTURES:

A. LED sources must meet the following requirements:

1. Operating temperature rating must be between −40°C and +50°C

2. Correlated Color Temperature (CCT):
   a. Nominal CCT: 2700 K (2725 ± 145)
   b. Nominal CCT: 3000 K (3045 ± 175)
   c. Nominal CCT: 3500 K (3465 ± 245)
   d. Nominal CCT: 4000 K (3985 ± 275)
   e. Nominal CCT: 4500 K (4503 ± 243)
   f. Nominal CCT: 5000 K (5028 ± 283)
   g. Nominal CCT: 5700 K (5665 ± 355)
   h. Nominal CCT: 6500 K (6530 ± 510)
   i. Du'v' tolerance of 0.001 ± 0.006

B. Color Rendering Index (CRI): greater or equal to 80.

C. Luminaire manufacturer must submit reliability reports indicating that the manufacturer of the LED (chip, diode, or package) has performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows:

1. High Temperature Operating Life (HTOL)
2. Room Temperature Operating Life (RTOL)
3. Low Temperature Operating Life (LTOL)
4. Powered Temperature Cycle (PTMCL)
5. Non–Operating Thermal Shock (TMSK)
6. Mechanical Shock
7. Variable Vibration Frequency
8. Solder Heat Resistance (SHR)
2.05 LED DRIVERS/POWER SUPPLIES

A. LED drivers must meet the following requirements:

1. Drivers must have a minimum efficiency of 85%

2. Starting Temperature: ~40°C

3. Electrical Characteristics
   a. Volts: as indicated on Luminaire Schedule.
   b. Phase: Single
   c. Hertz: 60

4. Power supplies can be UL Class I or II output.

5. Drivers must have a Power Factor (PF) of greater than or equal to 0.90

6. Drivers must have a Total Harmonic Distortion (THD) of 20% or less.


8. Drivers must be Reduction of Hazardous Substances (RoHS) compliant

9. Drivers must comply with requirements in section 2.5 B Controls

2.06 LED LUMINAIRES

A. Provide luminaires with integral LED thermal management system (heat sinking)

B. Luminaires shall be equipped with an LED driver that accepts 120V through 277V, 50hz to 60hz (UNIV). Component-to-component wiring within the luminaire will carry no more than 80% of rated current and be listed by UL for use at 600 VAC at 302°F/150°C or higher. Plug disconnects shall be listed by UL for use at 600 VAC, 15A or higher.

C. LED modules shall have a minimum L70 service life of 75,000 hours at 25°C ambient temperature and based on IESNA LM–80 methodology.

D. Provide luminaires with individual LED arrays / modules and drivers that are accessible and replaceable from exposed side of the luminaire. Luminaires requiring removal or replacement of entire luminaire to access LEDs and drivers will NOT be accepted.

E. Luminaires shall be listed by Design Lights Consortium

F. Housing: Rigid aluminum construction.

G. Finish: Visible surfaces. Powder coated paint or natural aluminum as specified in Light Fixture Schedule. Color and finish as selected by architect. Concealed parts, (lamp holders, yokes, brackets, etc.) matte black.

H. Lamp Holder Housing: Cast aluminum with integral heat radiating fins to assure cool lamp base operation, with sufficient heat dissipation to meet device manufacturer's guidelines, certification programs, and test procedures for thermal management.
I. Off-state Power: Luminaires shall not draw power in the off state. Exception: Luminaires with integral occupancy, motion, photo-controls or individually addressable fixtures with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.

2.07 LED DIMMERS

A. Provide dimmer and driver that are compatible and tested to comply with UL standards.
B. Continuous Flicker Free dimming range 100% to 1% measured relative light output. Relative humidity: maximum 90% non-condensing.
C. Power factor: greater than .90 at 25W
D. Total Harmonic Distortion: less than 20% at 25W
E. Inrush current <2A
F. Sound rating: Inaudible in a 24 dB ambient
G. Class P thermally protected
H. Meets FCC Part 15 Non-Consumer requirements for EMI/RFI emissions in a typical grounded fixture
I. Provide dimmers with Pulse Width Modulation for both constant current or constant wattage drivers to maintain LED color when dimming. Unless noted otherwise on the Luminaire Schedule.

2.08 WIRING

A. Wiring shall be as required by code for fixture wiring.
B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
C. Flexible cord wiring between fixture components or to electrical receptacle and not in wireways shall have a minimum temperature rating of 105°C.
D. Cords shall be fitted with proper strain reliefs and watertight entries where required by application.
E. No internal wiring shall be visible at normal viewing angles, i.e. above 45° from vertical.
F. Provide #18 AWG, 3-wire flexible conduit connections (whips) for dual level switching as shown on Drawings for light fixtures recessed in accessible suspended ceilings. Provide 3-wire whips for all dual level switching. Wire count on wire whips is not shown on Drawings and shall be the responsibility of the Contractor to provide proper wire count for the lighting control as shown on Drawings.

2.09 EXIT LIGHTS / EXIT SIGNS

A. Acceptable Manufacturers:
   1. As specified in the Light Fixture Schedule.
B. Provide cast aluminum stencil face Exit Signs with fully concealed chevron type directional arrow knockouts and universal mount canopy unless indicated otherwise on the Drawings.

C. Provide exit lights illuminated from light emitting diodes (LED) designed so that individual LEDs cannot be seen when the exit light is installed and illuminated.

D. Provide canopy, housing, stencil face and flange trim with white high temperature or polyester powder coat painted finish.

E. Letters shall be Red.

F. Do not install exit signs that utilize radioactive Tritium (^3H) gas to provide illumination.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install suspended exit signs using stem pendants from swivel hangers.

C. Install suspended luminaries using stem pendants from swivel hangers, aircraft cable, and chain in accordance with the intended design. Provide stem pendants, aircraft cable, and chain lengths required to suspend luminaire at indicated height.

D. Provide mounting accessories and trims as required for wall and ceiling construction types shown in Finish Schedule and on Drawings.

E. Lighting fixtures:
   1. Set level, plumb, and square with ceilings and walls unless otherwise indicated. Secure to prohibit movement
   2. Install lamps in each luminaire.

F. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

G. Verify weight and mounting method of fixtures and provide suitable supports. Fixture mounting assemblies shall comply with local seismic codes and regulations.

H. Support luminaire larger than 2’ x 4’ size, or heavier than 56 pounds independent of ceiling framing.

I. Locate recessed ceiling luminaires as indicated on reflected ceiling plan. Refer to architectural reflected ceiling plans for coordination of lighting fixture locations with mechanical and fire safety equipment. Where conflicts occur, coordinate with Architect prior to installing any of the systems.

J. Install recessed luminaires to permit removal from below.

K. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
L. Install clips to secure recessed grid-supported luminaires in place.

M. Install fixtures with vent holes free of air blocking obstacles.

N. Lighting fixtures located in recessed ceilings with a fire resistive rating of 1-hour or more shall be enclosed in an approved fire-resistant rated box equal to that of the ceiling.

O. Adjust aperture rings on all recessed fixtures to be flush with the finished ceiling.

P. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure.

Q. Install accessories furnished with each luminaire.

R. Install wall mounted luminaires and exit signs at height as indicated on Drawings.

S. Blemished, damaged or unsatisfactory fixtures or accessories shall be replaced.

T. For pendant mounted fixtures, mounting height is from finished ceiling to top of pendant light fixture. For wall mounted fixtures, center on outlet box unless otherwise noted. Verify mounting provisions and other requirements prior to order of light fixtures and provide as required.

U. In accessible suspended ceilings, provide 72" flexible conduit wiring connection (flexible tubing not permitted) from a rigidly supported junction box.

V. Bond products and metal accessories to branch circuit equipment grounding conductor.

W. All finishes shall be unmarred upon project completion. Repair or replace damaged finishes.

X. Install specified lamps in each luminaire.

Y. Replace all burned out or inoperative lamps at the end of the construction prior to Owner occupancy.

Z. Install continuous row fixtures as shown on drawings. The fixture type letter next to one fixture identifies all fixtures in the row. Rows are made up of either 4' or 8' long lamps in combination to complete the row. Design-Builder shall be responsible for quantities of fixtures required in any row and for supplying fixtures which are an interior continuous mounting or a fixture with end cap. The channels or fixtures may be longer than 4', but all plastic lenses, hinged doors and louver sections shall not exceed four feet long.

AA. Clean fixtures immediately before the final inspection. Provide fixtures newly lamped and in perfect operating condition at the completion of the job.

3.02 SUPPORT OF LED LIGHT FIXTURES

A. Recessed type: For light fixtures supported by the ceiling suspension system, provide four Caddy #515 (or as provided by the manufacturer) support clips (one each corner) which lock light fixture to ceiling tees after light fixture is installed. In addition, provide for each light fixture two #14 earthquake chains or #12 wires secured at diagonally opposite fixture corners (for fixtures weighing less than 56 pounds) to structural members above suspended ceiling. For plaster or gypsum board ceilings provide plaster frame compatible with light fixture. Contractor shall coordinate fixture trim with ceiling type.
B. Surface Mounted Type:

1. Where mounted on accessible ceilings, support from structural members above ceiling by means of hanger rods through ceiling or as approved.

2. Continuous Runs of Fixtures: Laser sight to assure fixtures are straight when sighting from end to end, regardless of irregularities in the ceiling. Where light fixtures are so installed, omit ornamental ends between sections.

C. Pendant Mounted Type:

1. For fixtures with rigid pendants, supply swivel ball aligners at canopy to comply with local seismic requirements.

2. Where suspended from accessible ceiling, support fixture from structural members above ceiling by means of hanger rods through ceiling or as accepted.

3. Continuous Runs of Light Fixtures: Laser sight to assure fixtures are straight when sighting from end to end, regardless of irregularities in the ceiling. Where light fixtures are so installed, omit ornamental ends between sections.

4. Where pendant is longer than 48 inches (1200mm), brace to as required by code or shown on drawings.

3.03 DIFFUSERS AND ENCLOSURES

A. Remove protective plastic covers from lighting fixture diffusers only after construction work, painting and clean-up are completed. Remove all dirty lamps, reflectors and diffusers; clean and reinstall. When cleaning "Alzak" reflectors, use a manufacturer recommended cleaning solution. Reflectors damaged or impregnated with fingerprints shall be replaced at no cost to Owner.

B. For LED fixtures, whether surface mounted or recessed, remove all construction dirt and dust from heat sink fins to ensure proper dissipation of heat.

3.04 ADJUSTMENT OF LIGHT FIXTURES

A. Aim and adjust luminaires as indicated on drawings.

B. Provide materials and labor for aiming and adjusting lighting fixture under Architects supervision. Aiming and adjusting shall take place immediately before building is turned over to Owner.

C. Adjust exit sign directional arrows as indicated.

D. Relamp luminaires that have failed lamps at Substantial Completion.

3.05 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connections and operation.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosure
D. Clean photometric control surfaces as recommended by manufacturer.

E. Inspect each installed fixture for damage. Replace damaged fixtures and components.

F. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
   1. Verify operation of photoelectric controls.

G. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.06 DEMONSTRATION
A. Provide minimum of two hours demonstration of luminaire operation.

3.07 CLEANING
A. Clean Work under provisions of Division 01.
B. Clean electrical parts to remove conductive and deleterious materials.
C. Remove dirt and debris from enclosure.
D. Clean photometric control surfaces as recommended by manufacturer.
E. Clean finishes and touch up damage.

3.08 ENERGY REBATES
A. Submit quantity invoices for all lamps and ballasts which qualify for energy rebates.
B. Apply for all applicable lamp and ballast energy rebates.
C. Retain samples of existing lamps and ballasts as proof of energy savings when required by the energy utility for rebate.
D. Coordinate with the electrical utility to facilitate rebate payments to be made directly to the Owner.

END OF SECTION 26 51 10.01
SECTION 26 61 00
LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The contractor shall furnish and install all branch circuit wiring and terminations as detailed by the plans and specifications to provide a complete lighting control system. The system shall include, but not be limited to the following: Pre-wired microprocessor controlled relay panels with electrically latched relays able to respond to both momentary (ON/OFF and Cycle) and maintained contact commands, as direct inputs or over a digital bus, and other devices required for a fully operational lighting control system. The Automatic Lighting Control System panel and the panel low voltage wiring shall be provided by the Building Automation Control System (BACS) Contractor under this section.

B. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable lighting control system.

C. The system shall be supplied by a lighting control system manufacturer with at least ten years experience in the lighting control industry.

D. Control panels shall be factory assembled and UL listed under the UL 508 standard.

E. Products must be certified by the California Energy Commission for compliance under Title 24, Part 6.

F. Requirements are indicated elsewhere in these specifications for work including, but not limited to, raceways and electrical boxes and fittings required for installation of control equipment and wiring.

G. Coordinate features of equipment and system components to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions.

1.2 RELATED WORK

A. Division 26 – Electrical Boxes and Fittings

B. Division 26 – Wiring Devices

C. Division 23 – Building Automation Control System (BACS).

1.3 REFERENCES

A. American National Standards Institute (ANSI)


C. UL 916 - Energy Management Equipment.
E. Lighting control panels shall be listed by a nationally recognized testing laboratory.

1.4 SUBMITTALS
A. Underwriters Laboratories, Inc. (UL) listing and factory test reports.
B. Internal and system wiring diagrams.
C. Single line diagram of the system configuration. Typical riser diagrams are not acceptable.
D. Control wiring and conduit layout and connections.
E. Floor plans to scale showing the location of each device and equipment.
F. Product data of all the components including but not limited to programmable central controllers, transceivers, panels, input relays, switches and other ancillary equipment.
G. Submit product data showing dimensions and ratings for all components per Division 01.
H. Submit manufacturers installation instructions under provisions of Division 01.
I. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable lighting control system.

1.5 PROJECT RECORD DOCUMENTS
A. Submit project record documents under provisions of Division 26.
B. Accurately record location of low voltage control panels, remote relay boxes and switches.

1.6 OPERATION AND MAINTENANCE DATA
A. Submit operation and maintenance data under provisions of Division 01.
B. Include replacement part numbers.

PART 2 - PERFORMANCE

2.1 PERFORMANCE
A. A control signal from a manual switch, an internal timing and control unit, or an external sensor or other control signal source is routed to the system control module. This module processes signal according to its programming and routes an “open” or “close” command to one or more relays in the power-supply circuits to groups of lighting fixtures or other loads.
B. The control system shall be pre-assembled, designed and manufactured specific for the facility to operate the lighting as follows:
C. Lighting shall be controlled by individually controlled zones:

1. Interior lighting shut-off from locations shown on Drawings.

2. Interior and exterior lighting photocell/day lighting multi-channel control.

3. During the time when lights in rooms is determined to be shut off, or controlled to a lower level, the system shall have the ability to turn interior light zones on and off automatically, and/or manually, simultaneously.

PART 3 - MATERIALS

3.1 LIGHTING CONTROL SYSTEM COMPONENTS

A. Acceptable products: TRIATEK, G.E. "TLC" lighting control system or equal.

B. The lighting control system shall be compatible with Johnson Controls "METASYS N2 serial communications interface or Johnson Controls "METASYS" integrator, provided and installed by Johnson Controls, Inc.

C. The lighting control panels shall contain all necessary hardware (transformers, relays, timers, fuses, switches, terminals etc.,) to control and/or connect to the lighting circuits specified for control. Barriers shall divide high voltage and class two compartments.

D. All lighting controls shall be pre-assembled, wired, and tested to operate as a complete integral system and shall provide the lighting control features specified in this section.

1. Automatic time control shall be solid state, 365-day control. The time switch shall have holiday scheduling, each programmable by date, automatic daylight savings, leap year adjustments, and battery backup of up to 72 hours. All time/date sensitive systems must be year 2000 compliant.

2. All power sources and transformers interior to the lighting control panel shall be independently fused. Spare fuses shall be included.

3. The lighting control panels shall have terminals providing the capability to tie in wiring to/from expansion control panels that may be installed remote from the main lighting control panel. The main panel shall provide low voltage (Class 2) control output signals for controlling expansion control panels.

4. All termination points shall be captive screw type, no wire lugging shall be required. Each termination point and control component shall be clearly labeled for easy field identification.

5. The lighting control panels shall provide termination points for connecting a low voltage photocell for interlocking control of exterior lighting.

6. An extended occupancy function shall be provided to allow extension of the occupancy schedule without re-programming of the system only for specified lighting control zones. This extended occupancy shall be configurable from one to twelve hours.

7. Where on/off control switches are not available to operate lighting levels, override
switches shall be installed in the lighting control panel door, and where indication on the Drawings, to operate these lighting levels. Override switches shall allow operation of lighting levels either on or off until the next programmed event. Override switch operation shall not depend on the operation of a time switch or other controller, but shall be hard wired, providing reliable operation of the lighting control zone. All switches shall be marked to indicate the light level for which they control. Panel mounted override switches shall be illuminated to annunciate the state of the lighting control level for which they control.

8. Two prints, specific for each lighting control panel, shall be provided in a clear print pocket mounted in the door. The print shall be specific indicating termination point of each lighting circuit controlled by number and panel name. Prints shall indicate location and lighting control level assigned to each lighting contactor.

E. Low voltage / Class 2 control capability. The lighting control panel shall include the following features:

1. Individual self-powered Class 2 latching transformer-relays. The transformer-relays shall be a combined Class 2 transformer and magnetic latching relay. The latch/unlatch mechanism of the relay shall operate by a momentary signal that changes the magnetic field and lines of flux. Relays with closing coils or solenoids shall not be acceptable. Transformer relay control circuits shall be 15 Vac open circuit and 200 mA short circuit maximum. Relay systems requiring external control transformers or systems without capability to operate all relays simultaneously shall not be acceptable. Load contacts will be rated 20 amps - ballast, tungsten and general use at 120 or 277 Vac and 1 horsepower at 120 Vac (G.E. RR9, Microlite, or equal, heavy duty two-coil momentary contact 20 amperes, 277 volts lighting control contacts and isolated contacts). Auxiliary contacts shall close concurrently with the line voltage contacts and serve to signal relay status through pilot devices, switch annunciation lights, or other monitors of load status.

2. All transformer-relays shall be installed and terminated completely in both high voltage and low voltage sections of the panel. High voltage termination points shall be factory labeled with breaker panel and circuit numbers at the termination point per project plans.

3. Configurable lighting control boards:
   a. Each board shall accept up to 8 or 16 transformer-relays and have connection points at each relay for two and three-wire momentary switches. Connection points for each of eight master switch inputs shall be on each board.
   b. Factory or field selectable master switch inputs shall be configurable to operate any, some or all relays in any combination of on or off functions. Each board shall be able to be connected by cable to adjacent boards for additional relay group control. All switch to transformer-relay operations, either individual or master group, shall be directly operated by a control switch or other dry contact input and shall not require programming or use of a computer or microprocessor controller for mapping inputs to relays.
   c. The status of each relay shall be displayed by an LED on the lighting
control board.

d. Each lighting control board shall have direct manual override buttons on/off for operating each relay independently regardless of wiring or connection to other relays or devices.

4. Each Relay may be controlled in the following ways.

a. By the Cycle Input used for local control. A momentary closure to the Switch Common (hot) connection causes the relay to close; the next momentary command causes the relay to open.

b. By the ON Input: A momentary closure to the Switch Common (hot) connection shall cause the relay to close. Further closures shall cause no change in status.

c. By the OFF Input: A momentary closure to the Switch Common (hot) connection shall cause the relay to Open. Further closures shall cause no change in status.

d. By the Master ON/OFF inputs in the power supply section: A momentary closure to the Switch Common (hot) connection shall cause all relays in the panel to turn either ON or OFF.

e. By the Maintained Input. Each relay shall have a Maintained input which is held at a nominal 12Vdc. Pulling this low with a contact closure to Pilot Common shall cause the relay to close; opening the contact shall cause the relay to open.

5. Any number of relays may be operated together by parallel connection of the ON & OFF inputs.

6. The lighting control panel shall be able to house and control multi-pole contactors for the operation of multi-circuit or multi-phase loads. The multi-pole contactors shall be electrically held and lighting rated for 20 amperes on a tungsten or ballast load. Contactors shall be compact, rail mount style for easy removal and service. System and switch logic controlling contactors shall be configurable and rated Class 2.

7. Expansion control panels shall expand the control of the main lighting control panel by accepting control signals from the main lighting control panel to operate remote lighting/load circuits. Expansion lighting control panels shall provide all Class 2, transformer relay and multi-pole contactor control functions as the main lighting control panel.

8. Wiring for expansion control panels shall not be run in same conduit as power conductors.

9. Switches, switch panels, switch inputs.

a. Switches shall be Class 2, three-wire momentary type for use as individual or master group control of transformer-relays. Where required, switches shall be factory installed and wired in the door of the enclosure.
b. Lighting control panel(s) shall accept contact switch inputs from other devices such as occupancy sensors, photocells, time clocks, building management systems, etc. Inputs must be dry contact type and operate as momentary on/off contacts or maintained contacts. Individual or group master switches shall be capable of controlling lights regardless of a controller or other input devices.

3.2 LCD TOUCH SCREEN

A. Where indicated on the construction documents, provide a lighting control system touchscreen interface by AMX, type AXU-MLC black/white touch panel or equal. Touch screen must seamlessly interface with the lighting control system.

B. Exact screen programming shall be submitted and approved prior to equipment release.

C. Provide several sample screens in the submittal as well as one VISIO, or AutoCad drawing of a general screen layout applicable for this project.

D. Provide all necessary equipment racks and wall mounts. Racks to have hinged middle section allowing rear access to rack mount control equipment.

E. A single data/control cable home-run to equipment rack is required from each touchscreen station. Cable carries data and power. Cable is to be provided, installed and connected by this section.

F. Each touchscreen unit shall have multiple pages of screen. Each screen shall address a minimum of 20 buttons. Each button will be a toggle type press once for on and press again for off. The button will be reverse highlighted when on and not highlighted when off.

G. Touchscreens are to be wall mounted unless otherwise indicated on the construction documents.

H. Provide, install and terminate control voltage conductors required between control rack and each data line power supply unit.

I. AMX interface shall have access up to 255 devices on lighting control network and shall have the capacity to add additional touch screens to the system at any time.

3.3 PHOTOCELLS

A. Low voltage photocells and day lighting sensors shall operate off of 24VAC and be compatible with the lighting control panels.

B. Adjustable aperture with on/off delay feature to eliminate nuisance cycling.

3.4 LOW VOLTAGE SWITCHES AND COVER PLATES

A. Switches shall be two-button with two normally open, 3-ampere, 28 VAC contacts providing a single-pole double throw configuration. Lighting switches shall be ivory, G.E. #RS2-32, Microlite, or equal. Cover plates for single switch shall be ivory, G.E. RP2-112, Microlite, or equal and for 2-switches in single gang box shall be ivory, G.E. ORP2-122, Microlite, or equal.
PART 4 - SYSTEM FEATURES

4.1 LIGHTING CONTROL SYSTEM SOFTWARE

A. The lighting control system shall be programmable, via a "MS Windows 98, NT, 2000" based computer operating system running the supplier's software package. Once programmed, the instruction database shall be downloaded to each panel via the 18 gauge, two conductor twisted pair. Systems which require the computer to stay on-line and connected 24/7 are not acceptable.

B. Software shall provide the following features.

1. Alphanumeric descriptions of each relay load and circuit.
2. Cause each relay to flicker before normal off sweeps.
3. Capture run/time data for proper adjustment of ON/OFF times after system has started up.
4. Independent scheduling of each relay panel.
5. Telephone override.

4.2 LAPTOP COMPUTER

A. Contractor shall provide a laptop computer, loaded with lighting control system software and data files, and all interface devices and cabling necessary to connect the computer directly to the lighting control system at designated panels, and via a telephone modem connection. The computer configuration must be approved by the University's Representative through the submittal process. The computer configuration must include, at a minimum, Intel Pentium-4 1.6 GHz processor, 512 MB RAM, 12.0GB Ultra ATA hard drive, 3.5" floppy drive, 32x CD-ROM, 4x AGP 16MB video card, internal 56K, V90 modem, full 15" viewable screen, and Lithium Ion battery.
circuits.

F. Installer shall check all wiring to lighting fixtures or other electrical loads for short circuits prior to terminating line and load wiring in the lighting control panel. Line and load wiring shall be terminated directly to lighting contactors for the lighting zone assigned.

G. Provide, install and terminate any interconnecting wiring between main control panels, expansion panels, photocells, switches and other interconnecting devices. Line voltage and Class 2 (low voltage) wiring shall be installed in their respective sections of the panels without cross over.

H. Provide on-site programming time with factory-trained personnel for the system set-up. Set up the software program and program the entire system in accordance with the University’s instructions which will be furnished during construction.

I. Provide a data jack inside a dedicated control panel for communication with the building automation system.

J. Provide accurate "as-built" Drawings indicating the load controlled by each relay and the identification number for that switch connected to an input and the identification number of that input. Provide three sets of space plans or reflected ceiling plans indicating which fixtures are controlled by each relay.

5.2 CONTROL WIRING INSTALLATION

A. Install wiring between control devices as specified in Division 16 Section "Wire and Cable" for low-voltage connections and Division 16 Section "Voice and Data Systems" for digital circuits.

B. Wiring Method: Install all wiring in conduit as specified in Division 16 Sections "Conduit" and "Boxes."

C. Bundle, train and support wiring in enclosures.

D. Ground equipment.

5.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer’s published torque tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A identification.

B. Identify components and power and control wiring according to Division 16 Section "Electrical Identification."

C. Label each system control module with a unique designation. Make designations on elevated components readable from floor.

PART 6 - COMMISSIONING, MANUFACTURER’S SUPPORT, WARRANTY AND TRAINING

6.1 COMMISSIONING, MANUFACTURER’S SUPPORT, WARRANTY, TRAINING

A. Lighting control system manufacturer shall provide reasonable technical phone assistance
to the contractor during installation of the lighting control system.

B. Provide a single site visit, factory system start-up checkout, and initial programming to assure proper installation and operation of the lighting control system. Factory shall be given at least two weeks notification to schedule checkout visit.

C. Lighting control system shall include a one-year warranty from defect in material or workmanship, provided the defect develops under normal and proper use.

D. Manufacturer shall provide one 16-hour training session, at the University's site, for personnel designated by University's Representative.

E. Factory support shall be available free of charge during the warranty period to answer programming and application questions. The manufacturer, or his representative, shall have a remote terminal capable of programming the system to support the User's personnel during this period. Include a modem, necessary cabling and telephone extension to support this telecommunications operation.

END OF SECTION 26 61 00
DIVISIONS 27 – 49
SECTION 27 05 28
PATHWAYS FOR COMMUNICATIONS SYSTEMS

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
7. Nonmetallic surface pathways.
8. Tele-power poles.
11. Polymer-concrete handholes and boxes for exterior underground cabling.
12. Fiberglass handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.
B. GRC: Galvanized rigid conduit.
C. IMC: Intermediate metal conduit.
D. RTC: Reinforced thermosetting resin conduit.

1.4 ACTION SUBMITTALS

A. Product data for the following:

1. Surface pathways
2. Wireways and fittings.
3. Tele-power poles.
5. Underground handholes and boxes.
1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
3. Underground ducts, piping, and structures in location of underground enclosures and handholes.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Data: Seismic rating for all pathway racks, enclosures, cabinets, equipment racks, and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-D.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated GRC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.
G. EMT: Comply with ANSI C80.3 and UL 797.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
   1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
   2. Fittings for EMT:
      a. Material: Steel or die cast.
      b. Type: Set screw.
   3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
   4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.

B. General Requirements for Nonmetallic Conduits and Fittings:
   1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
   2. Comply with TIA-569-D.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Rigid HDPE: Comply with UL 651A.

E. Continuous HDPE: Comply with UL 651A.

F. RTRC: Comply with UL 2515A and NEMA TC 14.

G. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.

H. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for general-use installation unless otherwise indicated.

B. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

C. Comply with TIA-569-D.
2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.

B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Wireway Covers: Hinged type unless otherwise indicated.

D. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

C. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Comply with TIA-569-D.

D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.6 SURFACE METAL PATHWAYS

A. Description: Galvanized steel with snap-on covers, complying with UL 5.

B. Finish: Manufacturer's standard enamel finish in color selected by Architect.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

2.7 SURFACE NONMETALLIC PATHWAYS:

A. Description: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC.
B. Finish: Texture and color selected by Architect from manufacturer's standard colors.

C. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

E. Comply with TIA-569-D.

2.8 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

C. Comply with TIA-569-D.

D. Galvanized steel.

E. J shape.

2.9 BOXES, ENCLOSURES, AND CABINETS

A. Description: Enclosures for communications.

B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-D.
2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep
5. Gangable boxes are allowed.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

G. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

H. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures:
   b. Finished inside with radio-frequency-resistant paint.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

I. Cabinets:
   1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.
   6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Indoors: Apply pathway products as specified below unless otherwise indicated:

   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
      a. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
      b. Mechanical rooms.
   4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   5. Damp or Wet Locations: GRC.
   6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
   7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.
   8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT.
   9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in institutional and commercial kitchens and damp or wet locations.

B. Minimum Pathway Size: 3/4-inch (21-mm) trade size for copper and aluminum cables, and 1 inch (25 mm) for optical-fiber cables.

C. Pathway Fittings: Compatible with pathways and suitable for use and location.

   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
   2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing
conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
E. Install surface pathways only where indicated on Drawings.
F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101
5. NECA 102.
6. NECA 105.
7. NECA 111.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Comply with requirements in Section 270528.29 "Hangers and Supports for Communications Systems" for hangers and supports.

E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.

F. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

G. Complete pathway installation before starting conductor installation.

H. Arrange stub-ups so curved portions of bends are not visible above finished slab.

I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.

J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches (300 mm) of enclosures to which attached.

L. Pathways Embedded in Slabs:
1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.

2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.

3. Arrange pathways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

M. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

Q. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.

R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.

S. Cut conduit perpendicular to the length. For conduits of 2-inch (50-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

T. Install pull wires in empty pathways. Use polypropylene or mono filament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

U. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).

2. 1-Inch (25-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).

3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
V. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

W. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

X. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

Y. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC that is located where environmental temperature change may exceed 100 deg F (55 deg C), and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   d. Attics: 135 deg F (75 deg C) temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Z. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches (150 mm) of slack. The lowest point of the cables shall be no less than 6 inches (150 mm) adjacent to ceilings, mechanical ductwork and fittings, luminaire, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 5 feet (1.5 m) o.c.
5. Provide a hook at each change in direction.

AA. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

BB. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

CC. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

FF. Set metal floor boxes level and flush with finished floor surface.

GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe of less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete around conduit for a minimum of 12 inches (300 mm) on each side of the coupling.
b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings at terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.

7. Underground Warning Tape: Comply with requirements in Section 270553 "Identification for Communications Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

F. Field cut openings for conduits according to enclosure manufacturer’s written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528
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. High-count Category 3 twisted pair cable.
2. High-count Category 5e twisted pair cable.
3. High-count Category 6 twisted pair cable.
5. Category 6a twisted pair cable.
6. Category 7 twisted pair cable.
7. Twisted pair cable hardware, including plugs, jacks, patch panels, and cross-connects.
10. Source quality control requirements for twisted pair cable.

B. Related Requirements:

1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

B. EMI: Electromagnetic interference.

C. IDC: Insulation displacement connector.

D. LAN: Local area network.

E. RCDD: Registered Communications Distribution Designer.

1.4 COPPER BACKBONE CABLING DESCRIPTION

A. Copper backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main...
cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration Drawings and printouts.
4. Wiring diagrams to show typical wiring schematics, including the following:
   a. Telecommunications rooms plans and elevations.
   b. Telecommunications pathways.
   c. Telecommunications system access points.
   d. Telecommunications grounding system
   e. Cross-connects.
   f. Patch panels.
   g. Patch cords.

5. Cross-Connects and Patch Panels: Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Twisted pair cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For RCDD, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Product Certificates: For each type of product.

D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

B. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On USB media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-Panel Units: One of each type.
2. Connecting Blocks: One of each type.
3. Plugs: Ten of each type.
4. Jacks: Ten of each type.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: Certified by BICSI.

1. Testing Agency’s Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair for open and short circuits.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner’s telecommunications and LAN equipment and service suppliers.
1.13 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

D. Grounding: Comply with TIA-607-B.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1200 by 2400 mm). Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

2.3 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Plenum Rated: Type CMP complying with UL 1685.
2. Communications, Plenum Rated: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
3. Communications, Riser Rated: Type CMR complying with UL 1666.
4. Communications, Riser Rated: Type CMP or Type CMR in listed plenum or riser communications raceway.
5. Communications, Riser Rated: Type CMP or Type CMR in metallic conduit installed according to NFPA 70, Article 300.22, “Wiring in Ducts, Plenums, and Other Air-Handling Spaces.”

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. RoHS compliant.

2.4 HIGH-COUNT CATEGORY 3 TWISTED PAIR CABLE

A. Description: 25 pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 3 cable at frequencies up to 16MHz.

B. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 3 cables.

C. Conductors: 100-ohm, 24 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP).

E. Cable Rating: Riser.

F. Jacket: White thermoplastic.

2.5 HIGH-COUNT CATEGORY 5e TWISTED PAIR CABLE

A. Description: 25 pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz.

B. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables.

C. Conductors: 100-ohm, 24 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP).

E. Cable Rating: Riser.

F. Jacket: White thermoplastic.

2.6 HIGH-COUNT CATEGORY 6 TWISTED PAIR CABLE

A. Description: 24 pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

C. Conductors: 100-ohm, 23 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP).

E. Cable Rating: Riser.

F. Jacket: White thermoplastic.

2.7 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.


C. Conductors: 100-ohm, 23 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP).

E. Cable Rating: Riser.

F. Jacket: White thermoplastic.

2.8 CATEGORY 6a TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz.

B. Standard: Comply with TIA-568-C.2 for Category 6a cables.

C. Conductors: 100-ohm, 23 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP).

E. Cable Rating: Riser.

F. Jacket: White thermoplastic.

2.9 CATEGORY 7 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 7 cable at frequencies up to 600MHz.

B. Standard: Comply with ISO 11801, Category F.

C. Conductors: 100-ohm, 22 AWG solid copper.

D. Shielding/Screening: Overall foil shield with foil shielded twisted pairs (F/FTP).
E. Cable Rating: Riser.

F. Jacket: White thermoplastic.

2.10 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

B. General Requirements for Cable Connecting Hardware:

1. Twisted pair cable hardware shall meet the performance requirements of Category 5e.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.
4. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.

C. Connecting Blocks: 110-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Features:
   a. Universal T568A and T568B wiring labels.
   b. Labeling areas adjacent to conductors.
   c. Replaceable connectors.
   d. 24 or 48 ports.

2. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
3. Number of Jacks per Field: One for each four-pair twisted pair cable indicated.

F. Plugs and Plug Assemblies:

1. Male; eight position (8P8C); color-coded modular telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded twisted pair cable.
3. Marked to indicate transmission performance.

G. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
4. Marked to indicate transmission performance.

H. Patch Cords: Factory-made, four-pair cables in 36-inch (900-mm) lengths; terminated with an eight-position modular plug at each end.
   1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
   2. Patch cords shall have color-coded boots for circuit identification.

I. Faceplates:
   1. Two port, vertical single gang faceplates designed to mount to single gang wall boxes.
   2. Eight port, vertical double gang faceplates designed to mount to double gang wall boxes.
   4. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
   5. For use with snap-in jacks accommodating any combination of twisted pair, optical-fiber, and coaxial work-area cords.
      a. Flush-mount jacks, positioning the cord at a 45-degree angle.

J. Legend:
   1. Factory labeled by silk-screening or engraving.

2.11 IDENTIFICATION PRODUCTS
   A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.12 GROUNDING
   A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
   B. Comply with TIA-607-B.

2.13 SOURCE QUALITY CONTROL
   A. Testing Agency: Engage a qualified testing agency to evaluate cables.
   B. Factory test cables on reels according to TIA-568-C.1.
   C. Factory test cables according to TIA-568-C.2.
D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer’s limitations on bending radii. Provide and use lacing bars and distribution spools. Install cables parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF PATHWAYS

A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings."

B. Comply with Section 270528 "Pathways for Communications Systems" for communications raceways. Drawings indicate general arrangement of pathways and fittings.

C. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF COPPER BACKBONE CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. General Requirements for Cabling:


3. Install 110-style IDC termination hardware unless otherwise indicated.

4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

6. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.

7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.

8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.

9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.


C. Cable Installation:

1. Comply with TIA-568-C.0 and TIA-568-C.2.

2. Do not untwist twisted pair cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend cable, not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.

2. Install cabling after the flooring system has been installed in raised floor areas.

3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:
1. Comply with recommendations from BICSI’s "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."


3.6 GROUNDING

A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

B. Comply with TIA-607-B and NECA/BICSI-607.
C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.

D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   1. Administration Class: 1.
   2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration.

D. Comply with requirements in Section 271513 "Communications Copper Horizontal Cabling" for cable and asset management software.

E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

G. Cable and Wire Identification:
   1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
   2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
   3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
   4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
      a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
      b. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

H. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-566-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

F. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

G. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

H. End-to-end cabling will be considered defective if it does not pass tests and inspections.

I. Prepare test and inspection reports.
END OF SECTION 271313
SECTION 28 05 13
CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

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. UTP cabling.
2. 50/125-micrometer, multimode optical-fiber cabling.
3. Coaxial cabling.
4. RS-232 cabling.
5. RS-485 cabling.
6. Control-voltage cabling.
7. Control-circuit conductors.
8. Fire alarm wire and cable.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.
B. IDC: Insulation displacement connector.
C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
D. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
E. RCDD: Registered Communications Distribution Designer.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of electronic safety and security cabling with Owner's telecommunications and LAN equipment and service suppliers.
B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.
1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Installation data for UTP and optical-fiber cables as specified in TIA 569-C-1.
   2. For coaxial cable, include the following installation data for each type used:
      a. Nominal OD.
      b. Minimum bending radius.
      c. Maximum pulling tension.

B. Shop Drawings:
   1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
   2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
   3. Cabling administration drawings and printouts.
   4. Wiring diagrams to show typical wiring schematics, including the following:
      b. Patch panels.
      c. Patch cords.
   5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
   1. Test optical-fiber cable to determine the continuity of the strand, end to end. Use optical-fiber flashlight.
2. Test optical-fiber cable on reels. Use an optical time domain reflectometer to verify the cable length, and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.

3. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."

2.3 UTP CABLE

A. Description: 100-ohm, four-pair UTP, covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA-568-C.1 for performance specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

   a. Communications, General Purpose: Type CM or Type CMG.
   b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
   c. Communications, Riser Rated: Type CMR, complying with UL 1666.
   d. Communications, Limited Purpose: Type CMX.
   e. Multipurpose: Type MP or Type MPG.
   f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
   g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

A. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.
B. Connecting Blocks: 110-style for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.5 OPTICAL-FIBER CABLE

A. Description: Multimode, 50/125-micrometer, 24-fiber, tight buffer, optical-fiber cable.

1. Comply with IEC 60793-5-5 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with TIA-492AAAB for detailed specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
   a. General Purpose, Non-conductive: Type OFN or Type OFNG.
   b. Plenum Rated, Non-conductive: Type OFNP, complying with NFPA 262.
   c. Riser Rated, Non-conductive: Type OFNR, complying with UL 1666.
   d. General Purpose, Conductive: Type OFC or Type OFCG.
   e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
   f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.

5. Conductive cable shall be aluminum armored type.
6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

B. Jacket:

2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.6 OPTICAL-FIBER CABLE HARDWARE

A. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

B. Patch Cords: Factory-made, dual-fiber cables in 36-inch (915-mm) lengths.


1. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.
2. Type SFF connectors may be used in termination racks, panels, and equipment packages.
2.7 COAXIAL CABLE

A. General Coaxial-Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data-transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 db maximum from 7 to 806 MHz.

B. RG-11/U: NFPA 70, Type CATV.
   1. No. 14 AWG, solid, copper-covered steel conductor.
   2. Gas-injected, foam-PE insulation.
   3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
   4. Jacketed with sunlight-resistant, black PVC or PE.
   5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.

C. RG-6/U: NFPA 70, Type CATV or CM.
   No. 18 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
   1. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
   2. Jacketed with PVC or PE.
   3. Suitable for indoor installations.

D. RG-6/U (Plenum Rated): NFPA 70, Type CMP.
   1. No. 18 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
   2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
   3. Jacketed with PE.

E. NFPA and UL Compliance: Coaxial cables shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70, Article 820 "Radio and Television Equipment" and Article 830 "Community Antenna Television and Radio Distribution Systems." Types are as follows:
   1. CATV Cable: Type CATV.
   2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
   3. CATV Riser Rated: Type CATVR, complying with UL 1566.
   4. CATV Limited Rating: Type CATVX.

2.8 COAXIAL-CABLE HARDWARE

A. Coaxial-Cable Connectors:
   1. Type BNC, 75 ohms, crimp on style.
   2. Type F compression style for RG-6/U cables.

2.9 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.
1. Three, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Polypropylene insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
4. PVC jacket.
5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
   1. Three, No. 22 AWG, stranded (7x30) tinned copper conductors.
   2. PE insulation.
   3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
   4. Fluorinated ethylene propylene jacket.
   5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

2.10 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM.
   1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
   2. PVC insulation.
   3. Unshielded.
   4. PVC jacket.
   5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
   1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
   2. Fluorinated ethylene propylene insulation.
   3. Unshielded.
   4. Fluorinated ethylene propylene jacket.

2.11 CONTROL-VOLTAGE CABLE

A. Paired Cable: NFPA 70, Type CMG.
   1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
   2. PVC insulation.
   3. Unshielded.
   4. PVC jacket.
   5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
   1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
   2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.12 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in pathway.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in pathway.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF in pathway, complying with UL 83.

2.13 FIRE ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NRTL listed for fire alarm and cable tray installation, plenum rated.

2.14 CONSOLIDATION POINTS

A. Description: Consolidation points shall comply with requirements for cable connecting hardware.

1. Number of Terminals per Field: One for each conductor in assigned cables.
2. Number of Connectors per Field:
   a. One for each four-pair UTP cable indicated.
   b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.

4. NRTL listed as complying with UL 50 and UL 1863.
5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.
2.15 IDENTIFICATION PRODUCTS
   A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
   B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

2.16 CABLE MANAGEMENT SYSTEM
   A. Description: Computer-based cable management system, with integrated database capabilities.
   B. Document physical characteristics by recording the network, TIA details, and connections between equipment and cable.
   C. Information shall be presented in database view.
      1. Microsoft Visio Professional or AutoCAD drawing software shall be used as drawing and schematic plans software.
   D. System shall interface with the following testing and recording devices:
      1. Direct upload tests from circuit-testing instrument into the personal computer.
      2. Direct download circuit labeling into labeling printer.

2.17 SOURCE QUALITY CONTROL
   A. Testing Agency: Engage a qualified testing agency to evaluate cables.
   B. Factory test UTP and optical-fiber cables on reels according to TIA-568-C.1.
   C. Factory test UTP cables according to TIA-568-C.2.
   D. Factory test multimode optical fiber cables according to TIA-526.14-B and TIA-568-C.3.
   E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results. Structural Return Loss shall be less than 20 db.
   F. Cable will be considered defective if it does not pass tests and inspections.
   G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS
   A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for installation of supports for cables.
3.2 WIRING METHOD

A. Install wiring in metal pathways and wireways.
   1. Minimum conduit size shall be 3/4 inch (21 mm) Control and data-transmission wiring shall not share conduits with other building wiring systems.
   2. Comply with requirements in Section 280528 "Pathways for Electronic Safety and Security."
   3. Comply with requirements in Section 260136 "Cable Trays for Electrical Systems."
   4. Comply with requirements in Section 270156 "Cable Trays for Communications Systems."

B. Install cable, concealed in accessible ceilings, walls, and floors when possible.

C. Wiring on Racks and within Enclosures:
   1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM's "Cabling Termination Practices" chapter. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered.
   2. Install lacing bars and distribution spools.
   3. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.
   4. Install conductors parallel with or at right angles to sides and back of enclosure.
   5. Connect conductors associated with intrusion system that are terminated, spliced, or interrupted in any enclosure onto terminal blocks.
   6. Mark each terminal according to system's wiring diagrams.
   7. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1 and NFPA 70.

B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.

C. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.

D. Install UTP, optical-fiber, and coaxial cables and connecting materials after spaces are complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

E. General Requirements for Cabling:
   2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
   3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels. Leave a minimum of 6 inches (150 mm) of slack at outlet terminations and coil loosely into box after termination on outlet fitting.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

5. Maintain minimum cable bending radius during installation and termination of cables.

6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions. Do not exceed manufacturer's rated cable-pulling tension.

9. Riser Cable: Riser cable support intervals shall be in accordance with manufacturer's recommendations.

10. Comply with Section 280544 "Sleeves and Sleeve Seals for Electronic Safety and Security Pathways and Cabling."

F. UTP Cable Installation: Install using techniques, practices, and methods that are consistent with Category 5e rating of components and that ensure Category 5e performance of completed and linked signal paths, end to end.

2. Install 110-style IDC termination hardware unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch (12 mm) from point of termination to maintain cable geometry.

G. Optical-Fiber Cable Installation:

2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

H. Coaxial-Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).
3. Install indoor cables in pathway.

I. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunication spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart. Cable supports shall be fastened to structural members or floor slabs in accordance with Section 260529 "Hangers and Supports for Electrical Systems."
3. Cable shall not be run in contact with pipes, ducts, or other potentially damaging items. Cables shall not be run through structural members or use structural members, pipes, ducts, or equipment as a support.

J. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Cable 72 inches (1830 mm) long shall be neatly coiled not less than 12 inches (300 mm) in diameter below each feed point.

K. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-C recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communication cables or cables in nonmetallic pathways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communication cables in grounded metallic pathways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between cables in grounded metallic pathways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or hp and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRE ALARM WIRING INSTALLATION

A. Comply with NEC A 1 and NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 28052B "Pathways for Electronic Safety and Security."

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.

C. Wiring Method:
1. Cables and pathways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.

2. Fire-Rated Cables: Use of two-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is permitted.

3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or pathway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system’s wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color Coding: Color code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and another for supervisory circuits. Color code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 POWER AND CONTROL-CIRCUIT CONDUCTORS

A. 120-V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.

B. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.6 CONNECTIONS

A. Comply with requirements in Section 281643 "Perimeter Security Systems" for connecting, terminating, and identifying wires and cables.

B. Comply with requirements in Section 281600 "Intrusion Detection" for connecting, terminating, and identifying wires and cables.
C. Comply with requirements in Section 281300 "Access Control" for connecting, terminating, and identifying wires and cables.

D. Comply with requirements in Section 282300 "Video Surveillance" for connecting, terminating, and identifying wires and cables.

E. Comply with requirements in Section 284619 "PLC Electronic Detention Monitoring and Control Systems" for connecting, terminating, and identifying wires and cables.

F. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

G. Comply with requirements in Section 283500 "Refrigerant Detection and Alarm" for connecting, terminating, and identifying wires and cables.

3.7 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-C, "Firestopping" Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.8 GROUNDING

A. For communication wiring, comply with J-STD-607-A and with BICSI TDMM's "Grounding, Bonding, and Electrical Protection" chapter.

B. For low-voltage wiring and cabling, comply with requirements in Section 280526 "Grounding and Bonding for Electronic Safety and Security."

3.9 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections.

1. Visually inspect UTP and optical-fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.

   a. Test instruments shall comply with or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical-Fiber Cable Tests:

   a. Test instruments shall comply with or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

   b. Link End-to-End Attenuation Tests:

      1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.

      2) Attenuation test results for links shall be less than 2.0 db. Attenuation test results shall be less than that calculated according to equation in TIA-568-C.1.

5. Coaxial-Cable Tests:

   a. Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements.

   b. Replace malfunctioning or damaged items.

   c. Retest until satisfactory performance and conditions are achieved.

   d. Use an agile receiver and signal strength meter or spectrum analyzer for testing.

   e. CCTV Sources: Connect receiver to the output of each CCTV signal source or the distribution amplifier associated with it.

   f. Test Schedule: Schedule tests after pretesting has successfully been completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.

   g. Operational Tests: Perform tests of operational system to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

   h. Distribution System Acceptance Tests:

      1) Field-Strength Instrument: Rated for minus 40-db mV measuring sensitivity and a frequency range of 54 to 812 MHz, minimum. Provide documentation of recent calibration against recognized standards.

      2) Signal Level and Picture Quality: Use a field-strength meter or spectrum analyzer, as well as a standard television receiver, to measure signal levels and check picture quality at all user-interface outlets.

         a) Test the signal strength in db mV at 55 and 750 MHz.

         b) Minimum acceptable signal level is zero db mV (1000 mV).
c) Maximum acceptable signal level over the entire bandwidth is 15 db mV.

d) Television receiver shall show no evidence of cross-channel intermodulation, ghost images, or beat interference.

i. Signal-to-Noise-Ratio Test: Use a field-strength meter to make a sequence of measurements at the output of the last distribution amplifier or of another agreed-on location in system. With system operating at normal levels, tune meter to the picture carrier frequency of each of the designated channels in turn, and record the level. With signal removed and input to corresponding headend amplifier terminated at 75 ohms, measure the level of noise at same tuning settings. With meter correction factor added to last readings, differences from first set shall not be less than 45 db.

j. Qualitative and Quantitative Performance Tests: Demonstrate reception quality of color-television program transmissions at each user interface from each designated channel and source. Quality shall be equal or superior to that obtained with performance checks specified below, using a standard, commercial, cable-ready, color-television receiver. Level and quality of signal at each outlet and from each service and source shall comply with the following Specifications when tested according to 47 604-12 76:

1) RF video-carrier level.
2) Relative video-carrier level.
3) Carrier-level stability, during 60-minute and 24-hour periods.
4) Broadband frequency response.
5) Channel frequency response.
6) Carrier-to-noise ratio.
7) RF visual signal-to-noise ratio.
8) Antenna combiner insertion loss.
9) Signal power splitter loss.
10) Cable connector attenuation.
11) Cross modulation.
12) Carrier-to-echo ratio.
13) Composite triple beat.
14) Second order beat.
15) Terminal isolation.
16) Terminal isolation between television and FM.
17) Hum modulation.
18) RF FM carrier level.
19) FM frequency response.
20) FM carrier-to-noise ratio.

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 280513
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetallic conduits, tubing, and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
8. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 260533 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.
3. Section 270528 "Pathways for Communications Systems" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving communications systems.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Sustainable Design Submittals:
C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

D. Samples: For wireways and for each color and texture specified, 12 inches (300 mm) long.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
   1. Structural members in paths of pathway groups with common supports.
   2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, and equipment racks and their mounting provisions, including those for internal components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
   4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. General Requirements for Metal Conduits and Fittings:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with TIA-569-B.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. ARC: Comply with ANSI C80.5 and UL 6A.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. FMC: Comply with UL 1; zinc-coated steel or aluminum.

H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:
   a. Material: Steel
   b. Type: Setscrew.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 467, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

B. ENT: Comply with NEMA TC 13 and UL 1653.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. LFNC: Comply with UL 1660.

E. Rigid HDPE: Comply with UL 651A.

F. Continuous HDPE: Comply with UL 651B.

G. RTRC: Comply with UL 1684A and NEMA TC 14.

H. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

I. Fittings for LFNC: Comply with UL 514B.

J. Solvents and Adhesives: As recommended by conduit manufacturer.
2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Description: Comply with UL 2024; flexible-type pathway, approved for riser installation unless otherwise indicated.
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with TIA-569-B.

2.4 METAL WIREFAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
   1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with TIA-569-B.

B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Wireway Covers: Hinged type unless otherwise indicated.

D. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREFAYS AND AUXILIARY GUTTERS

A. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with TIA-569-B.

B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

E. Solvents and Adhesives: As recommended by conduit manufacturer.
2.6 SURFACE PATHWAYS

A. General Requirements for Surface Pathways:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with TIA-569-B.

B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

2.7 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets:
   1. Comply with TIA-569-B.
   2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

G. Device Box Dimensions: 4-inches square by 2-1/8 inches deep (100 mm square by 60 mm deep.

H. Gangable boxes are allowed.

I. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Nonmetallic Enclosures:
      b. Finished inside with radio-frequency-resistant paint.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

K. Cabinets:
   1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.
   6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.8 CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
   1. Tests of materials shall be performed by an independent testing agency.
   2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
   3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Indoors: Apply pathway products as specified below unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
      a. Loading dock.
      b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
      c. Mechanical rooms.
      d. Gyms
   4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric-Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   6. Damp or Wet Locations: GRC.
   7. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT
   8. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.
9. Pathways for Concealed General Purpose Distribution of Optical-Fiber or Communications Cable: EMT.

10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

B. Minimum Pathway Size: 1/2-inch (16-mm) trade size. Minimum size for optical-fiber cables is 1 inch (27 mm).

C. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

E. Install surface pathways only where indicated on Drawings.

F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Complete pathway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications wiring conduits for which only two 90-degree bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
I. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
3. Arrange pathways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to conduit assembly to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits of 2-inch (53-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.

R. Surface Pathways:

1. Install surface pathway for surface electrical outlet boxes only where indicated on Drawings.
2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.
3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).
2. 1-Inch (27-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

T. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.

U. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   d. Attics: 135 deg F (75 deg C) temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use maximum of 72 inches (1830 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   1. Use LFMC in damp or wet locations subject to severe physical damage.
   2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electronic Safety and Security Pathways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 280528
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. Security access central-control station.
2. One or more security access networked workstations.
3. Security access operating system and application software.

1.3 DEFINITIONS

A. CCTV: Closed-circuit television.
B. CPU: Central processing unit.
C. Credential: Data assigned to an entity and used to identify that entity.
D. dpi: Dots per inch.
E. DTS: Digital Termination Service. A microwave-based, line-of-sight communication provided directly to the end user.
F. GFI: Ground fault interrupter.
G. Identifier: A credential card; keypad personal identification number; or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
H. I/O: Input/Output.
I. LAN: Local area network.
J. Location: A Location on the network having a PC-to-controller communications link, with additional controllers at the Location connected to the PC-to-controller link with a TIA 485-A communications loop. Where this term is presented with an initial capital letter, this definition applies.
K. PC: Personal computer. Applies to the central station, workstations, and file servers.

L. PCI Bus: Peripheral Component Interconnect. A peripheral bus providing a high-speed data path between the CPU and the peripheral devices such as a monitor, disk drive, or network.

M. PDF: Portable Document Format. The file format used by the Acrobat document-exchange-system software from Adobe.

N. RAS: Remote access services.

O. RF: Radio frequency.

P. ROM: Read-only memory. ROM data are maintained through losses of power.

Q. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

R. TWAIN: Technology without an Interesting Name. A programming interface that lets a graphics application, such as an image editing program or desktop publishing program, activate a scanner, frame grabber, or other image-capturing device.

S. UPS: Uninterruptible power supply.

T. USB: Universal serial bus.

U. WAN: Wide area network.

V. WAV: The digital audio format used in Microsoft Windows.

W. WMP: Windows media player.

X. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

Y. Windows: Operating system by Microsoft Corporation.

Z. Workstation: A PC with software that is configured for specific, limited security-system functions.


1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings. Test and evaluation data presented in Product Data shall comply with SIA BIO-01.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Diagrams for cable management system.
2. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
3. Wiring Diagrams. For power, signal, and control wiring. Show typical wiring schematics including the following:
   a. Workstation outlets, jacks, and jack assemblies.
   b. Patch cords.
   c. Patch panels.

5. Battery and charger calculations for central station, workstations, and controllers.

C. Product Schedules.

D. Samples: For workstation outlets, jacks, jack assemblies, and faceplates. For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   1. Microsoft Windows software documentation.
   2. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.
   3. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hardcopy submittal.
   4. System installation and setup guides with data forms to plan and record options and setup decisions.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   2. Laser Printers: Three toner cassettes and one replacement drum unit.
   3. Credential card blanks, ready for printing. Include enough credential cards for all personnel to be enrolled at the site plus an extra 50 percent for future use.
   4. Fuses of all kinds, power and electronic, equal to 10 percent of amount installed for each size used, but no fewer than three units.
1.8 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
   1. Cable installer must have on staff a registered communication distribution designer certified by Building Industry Consulting Service International.

B. Source Limitations: Obtain central station, workstations, controllers, Identifier readers, and all software through one source from single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70, "National Electrical Code."

E. Comply with SIA DC-01 and SIA DC-03.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Central Station, Workstations, and Controllers:
   1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F (10 and 30 deg C), and not more than 80 percent relative humidity, noncondensing.
   2. Open each container; verify contents against packing list; and file copy of packing list, complete with container identification, for inclusion in operation and maintenance data.
   3. Mark packing list with the same designations assigned to materials and equipment for recording in the system labeling schedules that are generated by software specified in "Cable and Asset Management Software" Article.
   4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.10 PROJECT CONDITIONS

A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
   1. Control Station: Rated for continuous operation in ambient conditions of 60 to 85 deg F (16 to 30 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
   2. Indoor, Controlled Environment: NEMA 250, Type 1 enclosure. System components, except the central-station control unit, installed in indoor environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.
   3. Indoor, Uncontrolled Environment: NEMA 250, enclosures. System components installed in indoor environments shall be rated for continuous operation in ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.
   4. Outdoor Environment: NEMA 250, NEMA 250 enclosures. System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to
90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h).

5. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.

6. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250 enclosures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 DESCRIPTION


B. System Software: Based on 32 bit, central-station, workstation operating system, server operating system, and application software. Software shall have the following capabilities:

1. Multiuser and multitasking to allow for independent activities and monitoring to occur simultaneously at different workstations.
2. Graphical user interface to show pull-down menus and a menu-tree format that complies with interface guidelines of Microsoft Windows.
3. System license for the entire system including capability for future additions that are within the indicated system size limits specified in this Section.
4. Open-architecture system that allows importing and exporting of data and interfacing with other systems that are compatible with Microsoft Windows.
5. Password-protected operator login and access.

C. Network connecting the central station and workstations shall be a LAN using Microsoft Windows-based TCP/IP with a capacity of connecting up to 99 workstations. System shall be portable across multiple communication platforms without changing system software.

D. Network(s) connecting PCs and controllers shall consist of one or more of the following:

1. Local area, IEEE 802.3 Fast Ethernet Gigabit-Ethernet star topology network based on TCP/IP.
2. Direct-connected, RS-232 cable from the COM port of the central station to the first controller, then RS-485 cable to interconnect the remaining controllers at that location.
3. Dial-up and cable modem connection using a standard cable or dial-up telephone line.

2.3 OPERATION

A. Security access system shall use a single database for access-control and credential-creation functions.
B. Distributed Processing: A fully distributed processing system.

1. Access-control information, including time, date, valid codes, access levels, and similar data, shall be downloaded to controllers so each controller can make access-control decisions.
2. Intermediate controllers for access control are prohibited.
3. In the event that communications with the central controller are lost, controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the central station.

C. Number of Locations:

1. Support at least 32,000 separate Locations using a single PC with combinations of direct-connect, dial-up, or TCP/IP LAN connections to each Location.
2. Each Location shall have its own database and history in the central station.
3. Locations may be combined to share a common database.

D. Data Capacity:

1. 130 different card-reader formats.
2. 999 comments.
3. 48 graphic file types for importing maps.

E. Location Capacity:

1. 128 reader-controlled doors.
2. 50,000 total-access credentials.
3. 2048 supervised alarm inputs.
4. 2048 programmable outputs.
5. 32,000 custom action messages per Location to instruct operator on action required when alarm is received.

F. System Network Requirements:

1. System components shall be interconnected and shall provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
2. Communication shall not require operator initiation or response and shall return to normal after partial- or total-network interruption such as power loss or transient upset.
3. System shall automatically annunciate communication failures to the operator and shall identify the communications link that has experienced a partial or total failure.
4. Communications controller may be used as an interface between the central-station display systems and the field device network. Communications controller shall provide functions required to attain the specified network communications performance.

G. Central station shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Central station shall control system networks to interconnect all system components, including workstations and field-installed controllers.

H. Field equipment shall include controllers, sensors, and controls.
1. Controllers shall serve as an interface between the central station and sensors and controls.
2. Data exchange between the central station and the controllers shall include down-line transmission of commands, software, and databases to controllers.
3. The up-line data exchange from the controller to the central station shall include status data such as intrusion alarms, status reports, and entry-control records.
4. Controllers are classified as alarm-annunciation or entry-control type.

I. System Response to Alarms:
1. Field device network shall provide a system end-to-end response time of one second(s) or less for every device connected to the system.
2. Alarms shall be annunciated at the central station within one second of the alarm occurring at a controller or at a device controlled by a local controller, and within 100 ms if the alarm occurs at the central station.
3. Alarm and status changes shall be displayed within 100 ms after receipt of data by the central station.
4. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within five seconds of alarm receipt at the security console.
5. This response time shall be maintained during system heavy load.

J. False-Alarm Reduction: The design of the central station and controllers shall contain features to reduce false alarms. Equipment and software shall comply with SIA CP-01.

K. Error Detection:
1. Use a cyclic code method to detect single- and double-bit errors, burst errors of eight bits or fewer, and at least 99 percent of all other multibit and burst errors between controllers and the central station.
2. Interactive or product error-detection codes alone will not be acceptable.
3. A message shall be in error if one bit is received incorrectly.
4. Retransmit messages with detected errors.
5. Allow for an operator-assigned two-digit decimal number to each communications link representing the number of retransmission attempts.
6. Central station shall print a communication failure alarm message when the number of consecutive retransmission attempts equals the assigned quantity.
7. Monitor the frequency of data transmission failure for display and logging.

L. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.

M. Door Hardware Interface:
1. Comply with requirements in Section 087100 "Door Hardware" and Section 087111 "Door Hardware (Descriptive Specification)" for door hardware required to be monitored or controlled by the security access system.
2. Electrical characteristics of controllers shall match the signal and power requirements of door hardware.
2.4 APPLICATION SOFTWARE

A. System Software: Based on 32 bit, Microsoft Windows central-station and workstation operating system and application software.
   1. Multiuser multitasking shall allow independent activities and monitoring to occur simultaneously at different workstations.
   2. Graphical user interface shall show pull-down menus and a menu-tree format.
   3. Capability for future additions within the indicated system size limits.
   4. Open architecture that allows importing and exporting of data and interfacing with other systems that are compatible with operating system.
   5. Password-protected operator login and access.

B. Peer Computer Control Software: Detect a failure of a central computer and cause the other central computer to assume control of all system functions without interruption of operation. Both central computers shall have drivers to support this mode of operation.

C. Application Software: Interface between the alarm annunciation and entry-control controllers to monitor sensors, operate displays, report alarms, generate reports, and help train system operators.
   1. Reside at the central station, workstations, and controllers as required to perform specified functions.
   2. Operate and manage peripheral devices.
   3. Manage files for disk I/O, including creating, deleting, and copying files; and automatically maintain a directory of all files, including size and location of each sequential and random-ordered record.
   4. Import custom icons into graphics to represent alarms and I/O devices.
   5. Globally link I/O so that any I/O can link to any other I/O within the same Location without requiring interaction with the host PC. This operation shall be at the controller.
   6. Globally code I/O links so that any access-granted event can link to any I/O with the same Location without requiring interaction with the host PC. This operation shall be at the controller.
   7. Messages from PC to controllers and controllers to controllers shall be on a polled network that utilizes check summing and acknowledgment of each message. Communication shall be automatically verified, buffered, and retransmitted if message is not acknowledged.
   8. Selectable poll frequency and message time-out settings shall handle bandwidth and latency issues for TCP/IP, RF, and other PC-to-controller communications methods by changing the polling frequency and the amount of time the system waits for a response.
   9. Automatic and encrypted backups for database and history backups shall be automatically stored at the central-control PC and encrypted with a nine-character alphanumeric password that must be used to restore or read data contained in backup.
   10. Operator audit trail for recording and reporting all changes made to database and system software.

D. Workstation Software:
   1. Password levels shall be individually customized at each workstation to allow or disallow operator access to program functions for each Location.
2. Workstation event filtering shall allow user to define events and alarms that will be displayed at each workstation. If an alarm is unacknowledged (not handled by another workstation) for a preset amount of time, the alarm will automatically appear on the filtered workstation.

E. Controller Software:

1. Controllers shall operate as autonomous, intelligent processing units.
   
a. Controllers shall make decisions about access control, alarm monitoring, linking functions, and door-locking schedules for their operation, independent of other system components.
   
b. Controllers shall be part of a fully distributed processing-control network.
   
c. The portion of the database associated with a controller, and consisting of parameters, constraints, and the latest value or status of points connected to that controller, shall be maintained in the controller.

2. The following functions shall be fully implemented and operational within each controller:
   
a. Monitoring inputs.
   
b. Controlling outputs.
   
c. Automatically reporting alarms to the central station.
   
d. Reporting of sensor and output status to the central station on request.
   
e. Maintaining real time, automatically updated by the central station at least once a day.
   
f. Communicating with the central station.
   
g. Executing controller resident programs.
   
h. Diagnosing.
   
i. Downloading and uploading data to and from the central station.

3. Controller Operations at a Location:
   
a. Up to 64 controllers connected to TIA 485-A communications loop. Globally operating I/O linking and anti-passback functions between controllers within the same Location without central-station or workstation intervention. Linking and anti-passback shall remain fully functional within the same Location even when the central station or workstations are off-line.
   
b. In the event of communication failure between the central station and a Location, there shall be no degradation in operations at the controllers at that Location. Controllers at each Location shall be connected to a memory buffer with a capacity to store up to 10,000 events; there shall be no loss of transactions in system history files until the buffer overflows.
   
c. Buffered events shall be handled in a first-in-first-out mode of operation.

4. Individual Controller Operation:
   
a. Controllers shall transmit alarms, status changes, and other data to the central station when communications circuits are operable. If communications are not available, controllers shall function in a stand-alone mode; operational data, including the status and alarm data normally transmitted to the central station, shall be stored for later transmission to the central station. Storage capacity for the latest 1024 events shall be provided at each controller.
Card-reader ports of a controller shall be custom configurable for at least 120 different card-reader or keypad formats. Multiple reader or keypad formats may be used simultaneously at different controllers or within the same controller.

Controllers shall provide a response to card readers or keypad entries in less than 0.25 seconds, regardless of system size.

Controllers that are reset, or powered up from a nonpowered state, shall automatically request a parameter download and reboot to their proper working state. This shall happen without any operator intervention.

Initial Startup: When controllers are brought on-line, database parameters shall be automatically downloaded to them. After initial download is completed, only database changes shall be downloaded to each controller.

On failure for any reason, controllers shall perform an orderly shutdown and force controller outputs to a predetermined failure-mode state, consistent with the failure modes shown and the associated control device.

After power is restored, following a power failure, startup software shall initiate self-test diagnostic routines, after which controllers shall resume normal operation.

After controller failure, if the database and application software are no longer resident, controllers shall not restart but shall remain in the failure mode until repaired. If database and application programs are resident, controllers shall immediately resume operation. If not, software shall be restored automatically from the central station.

5. Communications Monitoring:

a. System shall monitor and report status of TIA 485-A communications loop of each Location.

b. Communication status window shall display which controllers are currently communicating, a total count of missed polls since midnight, and which controller last missed a poll.

c. Communication status window shall show the type of CPU, the type of I/O board, and the amount of RAM for each controller.

6. Operating systems shall include a real-time clock function that maintains seconds, minutes, hours, day, date, and month. The real-time clock shall be automatically synchronized with the central station at least once a day to plus or minus 10 seconds. The time synchronization shall be automatic, without operator action and without requiring system shutdown.

F. PC-to-Controller Communications:

1. Central-station or workstation communications shall use the following:

a. Direct connection using serial ports of the PC.

b. TCP/IP LAN interface cards.

c. Dial-up or cable modems for connections to Locations.

2. Each serial port used for communications shall be individually configurable for "direct communications," "modem communications incoming and outgoing," or "modem communications incoming only," or as an ASCII output port. Serial ports shall have adjustable data transmission rates and shall be selectable under program control.

3. Use multiport communications board if more than two serial ports are needed.
a. Use a 4-, 8-, or 16-serial port configuration that is expandable to 32- or 64-serial ports.
b. Connect the first board to an internal PCI bus adapter card.

4. Direct serial, TCP/IP, and dial-up, cable, or satellite communications shall be alike in the monitoring or control of the system except for the connection that must first be made to a dial-up or voice-over IP Location.
5. TCP/IP network interface card (NIV) shall have an option to set the poll-frequency and message-response time-out settings.
6. PC-to-controller and controller-to-controller communications (direct, dial-up, or TCP/IP) shall use a polled-communication protocol that checks sum and acknowledges each message. All communications in this subparagraph shall be verified and buffered, and retransmitted if not acknowledged.

G. Direct Serial or TCP/IP PC-to-Controller Communications:

1. Communication software on the PC shall supervise the PC-to-controller communications link.
2. Loss of communications to any controller shall result in an alarm at all PCs running the communication software.
3. When communications are restored, all buffered events shall automatically upload to the PC, and any database changes shall be automatically sent to the controller.

H. Dial-up Modem or Cable Modem PC-to-Controller Communications:

1. Communication software on the PC shall supervise the PC-to-controller communications link during dial-up modem connect times.
2. Communication software shall be programmable to routinely poll each of the remote dial-up or cable modem Locations, collecting event logs and verifying phone lines at operator-selectable time intervals for each Location.
3. System shall be programmable for dialing and connecting to all dial-up or cable modem Locations and for retrieving the accrued history transactions on an automatic basis as often as once every 10 minutes and up to once every 9999 minutes.
4. Failure to communicate to a dial-up Location three times in a row shall result in an alarm at the PC.
5. Time offset capabilities shall be present so that Locations in a different geographical time zone than the host PC will be set to, and maintained at, the proper local time. This feature shall allow for geographical time zones that are ahead of or behind the host PC.
6. The controller connected to a dial-up or cable modem shall automatically buffer all normal transactions until its buffer reaches 80 percent of capacity. When the transaction buffer reaches 80 percent, the controller shall automatically initiate a call to the central station and upload all transactions.
7. Alarms shall be reported immediately.
8. Dial-up or cable modems shall be provided by manufacturer of the system. Modems used at the controller shall be powered by the controller. Power to the modem shall include battery backup if the controller is so equipped.

I. Controller-to-Controller Communications:

1. TIA 485-A, four-wire, point-to-point, regenerative (repeater) communications network methodology.
2. TIA 485-A communications signal shall be regenerated at each controller.
J. Database Downloads:

1. All data transmissions from PCs to a Location, and between controllers at a Location, shall include a complete database checksum to check the integrity of the transmission. If the data checksum does not match, a full data download shall be automatically retransmitted.
2. If a controller is reset for any reason, it shall automatically request and receive a database download from the PC. The download shall restore data stored at the controller to their normal working state and shall take place with no operator intervention.
3. Software shall provide for setting downloads via dial-up connection to once per 24-hour period, with time selected by the operator.
4. Software shall provide for setting delays of database downloads for dial-up connections. Delays change the download from immediately to a delay ranging from one to 999 minutes.

K. Operator Interface:

1. Inputs in system shall have two icon representations, one for the normal state and one for the abnormal state.
2. When viewing and controlling inputs, displayed icons shall automatically change to the proper icon to display the current system state in real time. Icons shall also display the input's state, whether armed or bypassed, and if the input is in the armed or bypassed state due to a time zone or a manual command.
3. Outputs in system shall have two icon representations, one for the secure (locked) state and one for the open (unlocked) state.
4. Icons displaying status of the I/O points shall be constantly updated to show their current real-time condition without prompting by the operator.
5. The operator shall be able to scroll the list of I/Os and press the appropriate toolbar button, or right click, to command the system to perform the desired function.
6. Graphic maps or drawings containing inputs, outputs, and override groups shall include the following:
   a. Database to import and store full-color maps or drawings and allow for input, output, and override group icons to be placed on maps.
   b. Maps to provide real-time display animation and allow for control of points assigned to them.
   c. System to allow inputs, outputs, and override groups to be placed on different maps.
   d. Software to allow changing the order or priority in which maps will be displayed.
7. Override Groups Containing I/Os:
   a. System shall incorporate override groups that provide the operator with the status and control over user-defined "sets" of I/Os with a single icon.
   b. Icon shall change automatically to show the live summary status of points in that group.
   c. Override group icon shall provide a method to manually control or set to time-zone points in the group.
   d. Override group icon shall allow the expanding of the group to show icons representing the live status for each point in the group, individual control over each point, and the ability to compress the individual icons back into one summary icon.
8. Schedule Overrides of I/Os and Override Groups:
   a. To accommodate temporary schedule changes that do not fall within the holiday parameters, the operator shall have the ability to override schedules individually for each input, output, or override group.
   b. Each schedule shall be composed of a minimum of two dates with separate times for each date.
   c. The first time and date shall be assigned the override state that the point shall advance to when the time and date become current.
   d. The second time and date shall be assigned the state that the point shall return to when the time and date become current.

9. Copy command in database shall allow for like data to be copied and then edited for specific requirements, to reduce redundant data entry.

L. Operator Access Control:

1. Control operator access to system controls through three password-protected operator levels. System operators and managers with appropriate password clearances shall be able to change operator levels for operators.
2. Three successive attempts by an operator to execute functions beyond their defined level during a 24-hour period shall initiate a software tamper alarm.
3. A minimum of 32 passwords shall be available with the system software. System shall display the operator's name or initials in the console's first field. System shall print the operator's name or initials, action, date, and time on the system printer at login and logoff.
4. The password shall not be displayed or printed.
5. Each password shall be definable and assignable for the following:
   a. Selected commands to be usable.
   b. Access to system software.
   c. Access to application software.
   d. Individual zones that are to be accessed.
   e. Access to database.

M. Operator Commands:

1. Command Input: Plain-language words and acronyms shall allow operators to use the system without extensive training or data-processing backgrounds. System prompts shall be a word, a phrase, or an acronym.
2. Command inputs shall be acknowledged and processing shall start in not less than one (1) second.
3. Tasks that are executed by operator's commands shall include the following:
   a. Acknowledge Alarms: Used to acknowledge that the operator has observed the alarm message.
   b. Place Zone in Access: Used to remotely disable intrusion-alarm circuits emanating from a specific zone. System shall be structured so that console operator cannot disable tamper circuits.
   c. Place Zone in Secure: Used to remotely activate intrusion-alarm circuits emanating from a specific zone.
   d. System Test: Allows the operator to initiate a system-wide operational test.
e. Zone Test: Allows the operator to initiate an operational test for a specific zone.

f. Print reports.

g. Change Operator: Used for changing operators.

h. Security Lighting Controls: Allows the operator to remotely turn on or turn off security lights.

i. Display Graphics: Used to show any graphic displays implemented in the system. Graphic displays shall be completed within 20 seconds from time of operator command.

j. Run system tests.

k. Generate and format reports.

l. Request help with the system operation.

1. Include in main menus.

2) Provide unique, descriptive, context-sensitive help for selections and functions with the press of one function key.

3) Provide navigation to specific topic from within the first help window.

4) Help shall be accessible outside the application program.

m. Entry-Control Commands:

1) Lock (secure) or unlock (open) each controlled entry and exit up to four a day through time-zone programming.

2) Arm or disarm each monitored input up to four times a day through time-zone programming.

3) Enable or disable readers or keypads up to two times a day through time-zone programming.

4) Enable or disable cards or codes up to four times a day per entry point through access-level programming.

4. Command Input Errors: Show operator input assistance when a command cannot be executed because of operator input errors. Assistance screen shall use plain-language words and phrases to explain why the command cannot be executed. Error responses that require an operator to look up a code in a manual or other document are not acceptable. Conditions causing operator assistance messages include the following:

a. Command entered is incorrect or incomplete.

b. Operator is restricted from using that command.

c. Command addresses a point that is disabled or out of service.

d. Command addresses a point that does not exist.

e. Command is outside the system's capacity.

N. Alarms:

1. System Setup:

a. Assign manual and automatic responses to incoming-point status change or alarms.

b. Automatically respond to input with a link to other inputs, outputs, or operator-response plans; unique sound with use of WAV files; and maps or images that graphically represent the point location.

c. Sixty-character message field for each alarm.
d. Operator-response-action messages shall allow message length of at least 65,000 characters, with database storage capacity of up to 32,000 messages. Setup shall assign messages to access point.

e. Secondary messages shall be assignable by the operator for printing to provide further information and shall be editable by the operator.

f. Allow 25 secondary messages with a field of four lines of 60 characters each.

g. Store the most recent 1000 alarms for recall by the operator using the report generator.

2. Software Tamper:

a. Annunciate a tamper alarm when unauthorized changes to system database files are attempted. Three consecutive unsuccessful attempts to log onto system shall generate a software tamper alarm.

b. Annunciate a software tamper alarm when an operator or other individual makes three consecutive unsuccessful attempts to invoke functions beyond the authorization level.

c. Maintain a transcript file of the last 5000 commands entered at each central station to serve as an audit trail. System shall not allow write access to system transcript files by anyone, regardless of their authorization level.

d. Allow only acknowledgment of software tamper alarms.

3. Read access to system transcript files shall be reserved for operators with the highest password authorization level available in system.

4. Animated Response Graphics: Highlight alarms with flashing icons on graphic maps; display and constantly update the current status of alarm inputs and outputs in real time through animated icons.

5. Multimedia Alarm Annunciation: WAV files to be associated with alarm events for audio annunciation or instructions.

6. Alarm Handling: Each input may be configured so that an alarm cannot be cleared unless it has returned to normal, with options of requiring the operator to enter a comment about disposition of alarm. Allow operator to silence alarm sound when alarm is acknowledged.

7. Alarm Automation Interface: High-level interface to central-station alarm automation software systems. Allows input alarms to be passed to and handled by automation systems in the same manner as burglar alarms, using a TIA 232-F ASCII interface.

8. CCTV Alarm Interface: Allow commands to be sent to CCTV systems during alarms (or input change of state) through serial ports.

9. Camera Control: Provides operator ability to select and control cameras from graphic maps.

O. Alarm Monitoring: Monitor sensors, controllers, and DTS circuits and notify operators of an alarm condition. Display higher-priority alarms first and, within alarm priorities, display the oldest unacknowledged alarm first. Operator acknowledgment of one alarm shall not be considered acknowledgment of other alarms nor shall it inhibit reporting of subsequent alarms.

1. Displayed alarm data shall include type of alarm, location of alarm, and secondary alarm messages.

2. Printed alarm data shall include type of alarm, location of alarm, date and time (to nearest second) of occurrence, and operator responses.

3. Maps shall automatically display the alarm condition for each input assigned to that map if that option is selected for that input location.
4. Alarms initiate a status of "pending" and require the following two handling steps by operators:
   a. First Operator Step: "Acknowledged." This action shall silence sounds associated with the alarm. The alarm remains in the system "Acknowledged" but "Un-Resolved."
   b. Second Operator Step: Operators enter the resolution or operator comment, giving the disposition of the alarm event. The alarm shall then clear.

5. Each workstation shall display the total pending alarms and total unresolved alarms.

6. Each alarm point shall be programmable to disallow the resolution of alarms until the alarm point has returned to its normal state.

7. Alarms shall transmit to the central station in real time except for allowing connection time for dial-up locations.

8. Alarms shall be displayed and managed from a minimum of four different windows.
   a. Input Status Window: Overlay status icon with a large red blinking icon. Selecting the icon will acknowledge the alarm.
   b. History Log Transaction Window: Display name, time, and date in red text. Selecting red text will acknowledge the alarm.
   c. Alarm Log Transaction Window: Display name, time, and date in red. Selecting red text will acknowledge the alarm.
   d. Graphic Map Display: Display a steady colored icon representing each alarm input location. Change icon to flashing red when the alarm occurs. Change icon from flashing red to steady red when the alarm is acknowledged.

9. Once an alarm is acknowledged, the operator shall be prompted to enter comments about the nature of the alarm and actions taken. Operator’s comments may be manually entered or selected from a programmed predefined list, or a combination of both.

10. For locations where there are regular alarm occurrences, provide programmed comments. Selecting that comment shall clear the alarm.

11. The time and name of the operator who acknowledged and resolved the alarm shall be recorded in the database.

12. Identical alarms from the same alarm point shall be acknowledged at the same time the operator acknowledges the first alarm. Identical alarms shall be resolved when the first alarm is resolved.

13. Alarm functions shall have priority over downloading, retrieving, and updating database from workstations and controllers.

14. When a reader-controlled output (relay) is opened, the corresponding alarm point shall be automatically bypassed.

P. Monitor Display: Display text and graphic maps that include zone status integrated into the display. Colors are used for the various components and current data. Colors shall be uniform throughout the system.

1. Color Code:
   a. FLASHING RED: Alerts operator that a zone has gone into an alarm or that primary power has failed.
   b. STEADY RED: Alerts operator that a zone is in alarm and alarm has been acknowledged.
   c. YELLOW: Advises operator that a zone is in access.
d. GREEN: Indicates that a zone is secure and that power is on.

2. Graphics:
   a. Support 32,000 graphic display maps and allow import of maps from a minimum of 16 standard formats from another drawing or graphics program.
   b. Allow I/O to be placed on graphic maps by the drag-and-drop method.
   c. Operators shall be able to view the inputs, outputs, and the point's name by moving the mouse cursor over the point on the graphic map.
   d. Inputs or outputs may be placed on multiple graphic maps. The operator shall be able to toggle to view graphic maps associated with I/Os.
   e. Each graphic map shall have a display-order sequence number associated with it to provide a predetermined order when toggled to different views.
   f. Camera icons shall have the ability to be placed on graphic maps that, when selected by an operator, will open a video window, display the camera associated with that icon, and provide pan-tilt-zoom control.
   g. Input, output, or camera placed on a map shall allow the ability to arm or bypass an input, open or secure an output, or control the pan-tilt-zoom function of the selected camera.

Q. System test software enables operators to initiate a test of the entire system or of a particular portion of the system.

1. Test Report: The results of each test shall be stored for future display or printout. The report shall document the operational status of system components.

R. Report-Generator Software: Include commands to generate reports for displaying, printing, and storing on disk and tape. Reports shall be stored by type, date, and time. Report printing shall be the lowest-priority activity. Report-generation mode shall be operator selectable but set up initially as periodic, automatic, or on request. Include time and date printed and the name of operator generating the report. Report formats may be configured by operators.

1. Automatic Printing: Setup shall specify, modify, or inhibit the report to be generated; the time the initial report is to be generated; the time interval between reports; the end of the period; and the default printer.
2. Printing on Request: An operator may request a printout of any report.
3. Alarm Reports: Reporting shall be automatic as initially set up. Include alarms recorded by system over the selected time and information about the type of alarm, the type of sensor, the location, the time, and the action taken.
4. Access and Secure Reports: Document zones placed in access, the time placed in access, and the time placed in secure mode.
5. Custom Reports: Reports tailored to exact requirements of who, what, when, and where. As an option, custom report formats may be stored for future printing.
7. Cardholder Reports: Include data, or selected parts of the data, as well as the ability to be sorted by name, card number, imprinted number, or by any of the user-defined fields.
8. Cardholder by Reader Reports: Based on who has access to a specific reader or group of readers by selecting the readers from a list.
9. Cardholder by Access-Level Reports: Display everyone that has been assigned to the specified access level.
10. Who Is "In" (Muster) Report:
b. Cardholder Report. Contain a count of persons who are "In" at a selected Location and a detailed listing of name, date, and time of last use, sorted by the last reader used or by the group assignment.

11. Panel Labels Reports: Printout of control-panel field documentation including the actual location of equipment, programming parameters, and wiring identification. Maintain system installation data within system database so that data are available on-site at all times.

12. Activity and Alarm On-Line Printing: Activity printers for use at workstations; prints all events, or alarms only.

13. History Reports: Custom reports that allow the operator to select any date, time, event type, device, output, input, operator, Location, name, or cardholder to be included or excluded from the report.
   a. Initially store history on the hard disk of the host PC.
   b. Permit viewing of the history on workstations or print history to any system printer.
   c. The report shall be definable by a range of dates and times with the ability to have a daily start and stop time over a given date range.
   d. Each report shall depict the date, time, event type, event description, and device; or I/O name, cardholder group assignment, and cardholder name or code number.
   e. Each line of a printed report shall be numbered to ensure that the integrity of the report has not been compromised.
   f. Total number of lines of the report shall be given at the end of the report. If the report is run for a single event such as "Alarms," the total shall reflect how many alarms occurred during that period.

14. Reports shall have the following four options:
   a. View on screen.
   b. Print to system printer. Include automatic print spooling and "Print To" options if more than one printer is connected to the system.
   c. "Save to File" with full path statement.
   d. System shall have the ability to produce a report indicating status of system inputs and outputs or of inputs and outputs that are abnormal, out of time zone, manually overridden, not reporting, or in alarm.

15. Custom Code List Subroutine: Allow the access codes of system to be sorted and printed according to the following criteria:
   a. Active, inactive, or future activate or deactivate.
   b. Code number, name, or imprinted card number.
   c. Group, Location access levels.
   d. Start and stop code range.
   e. Codes that have not been used since a selectable number of days.
   f. In, out, or either status.
   g. Codes with trace designation.

16. The reports of system database shall allow options so that every data field may be printed.
17. The reports of system database shall be constructed so that the actual position of the printed data shall closely match the position of the data on the data-entry windows.
S. Anti-Passback:

1. System shall have global and local anti-passback features, selectable by Location. System shall support hard and soft anti-passback.
2. Hard Anti-Passback: Once a credential holder is granted access through a reader with one type of designation (IN or OUT), the credential holder may not pass through that type of reader designation until the credential holder passes through a reader of opposite designation.
3. Soft Anti-Passback: Should a violation of the proper IN or OUT sequence occur, access shall be granted, but a unique alarm shall be transmitted to the control station, reporting the credential holder and the door involved in the violation. A separate report may be run on this event.
4. Timed Anti-Passback: A controller capability that prevents an access code from being used twice at the same device (door) within a user-defined amount of time.
5. Provide four separate zones per Location that can operate without requiring interaction with the host PC (done at controller). Each reader shall be assignable to one or all four anti-passback zones. In addition, each anti-passback reader can be further designated as "Hard," "Soft," or "Timed" in each of the four anti-passback zones. The four anti-passback zones shall operate independently.
6. The anti-passback schemes shall be definable for each individual door.
7. The Master Access Level shall override anti-passback.
8. System shall have the ability to forgive (or reset) an individual credential holder or the entire credential-holder population anti-passback status to a neutral status.

T. Visitor Assignment:

1. Provide for and allow an operator to be restricted to only working with visitors. The visitor badging subsystem shall assign credentials and enroll visitors. Allow only those access levels that have been designated as approved for visitors.
2. Provide an automated log of visitor name, time and doors accessed, and name of person contacted.
3. Allow a visitor designation to be assigned to a credential holder.
4. Security access system shall be able to restrict the access levels that may be assigned to credentials issued to visitors.
5. Allow operator to recall visitors’ credential-holder file once a visitor is enrolled in the system.
6. The operator may designate any reader as one that deactivates the credential after use at that reader. The history log shall show the return of the credential.
7. System shall have the ability to use the visitor designation in searches and reports. Reports shall be able to print all or any visitor activity.

U. Time and Attendance:

1. Time and attendance reporting shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length designated in the report.
2. Shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length designated in the report.
3. System software setup shall allow designation of selected access-control readers as time and attendance hardware to gather the clock-in and clock-out times of the users at these readers.
a. Reports shall show in and out times for each day, total time in for each day, and a total time in for period specified by the user.

b. Allow the operator to view and print the reports, or save the reports to a file.

c. Alphabetically sort reports on the person's last name, by Location or location group. Include all credential holders or optionally select individual credential holders for the report.

V. Training Software: Enables operators to practice system operation, including alarm acknowledgment, alarm assessment, response force deployment, and response force communications. System shall continue normal operation during training exercises and shall terminate exercises when an alarm signal is received at the console.

W. Entry-Control Enrollment Software: Database management functions that allow operators to add, delete, and modify access data as needed.

1. The enrollment station shall not have alarm response or acknowledgment functions.

2. Provide multiple, password-protected access levels. Database management and modification functions shall require a higher operator access level than personnel enrollment functions.

3. The program shall provide means to disable the enrollment station when it is unattended, to prevent unauthorized use.

4. The program shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations. In the case of personnel identity-verification subsystems, this shall include biometric data. Allow entry of personnel identifying information into the system database using menu selections and data fields. The data field names shall be customized during setup to suit user and site needs. Personnel identity-verification subsystems selected for use with the system shall fully support the enrollment function and shall be compatible with the entry-control database files.

5. Cardholder Data: Provide 99 user-defined fields. System shall have the ability to run searches and reports using any combination of these fields. Each user-defined field shall be configurable, using any combination of the following features:

a. MASK: Determines a specific format with which data must comply.

b. REQUIRED: Operator is required to enter data into field before saving.

c. UNIQUE: Data entered must be unique.

d. DEACTIVATE DATE: Data entered will be evaluated as an additional deactivate date for all cards assigned to this cardholder.

e. NAME ID: Data entered will be considered a unique ID for the cardholder.

6. Personnel Search Engine: A report generator with capabilities such as search by last name, first name, group, or any predetermined user-defined data field; by codes not used in definable number of days; by skills; or by seven other methods.

7. Multiple Deactivate Dates for Cards: User-defined fields to be configured as additional stop dates to deactivate any cards assigned to the cardholder.

8. Batch card printing.

9. Default card data can be programmed to speed data entry for sites where most card data are similar.


11. Card Expire Function: Allows readers to be configured to deactivate cards when a card is used at selected devices.
2.5 SYSTEM DATABASE

A. Database and database management software shall define and modify each point in database using operator commands. Definition shall include parameters and constraints associated with each system device.

B. Database Operations:

1. System data management shall be in a hierarchical menu-tree format, with navigation through expandable menu branches and manipulated with use of menus and icons in a main menu and system toolbar.

2. Navigational Aids:

   a. Toolbar icons for add, delete, copy, print, capture image, activate, deactivate, and muster report.
   b. Point and click feature to facilitate data manipulation.
   c. Next and previous command buttons visible when editing database fields to facilitate navigation from one record to the next.
   d. Copy command and copy tool in the toolbar to copy data from one record to create a new similar record.

3. Data entry shall be automatically checked for duplicate and illegal data and shall be verified for valid format.

4. System shall generate a memo or note field for each item that is stored in database, allowing the storing of information about any defining characteristics of the item. Memo field is used for noting the purpose for which the item was entered, reasons for changes that were made, and the like.

C. File Management:

1. File management shall include database backup and restoration system, allowing selection of storage media, including 3.5-inch floppy disk, Zip and Jaz drives, and designated network resources.

2. Operations shall be both manual and automatic modes. The number of automatic sequential backups before the oldest backup will be overwritten; FIFO mode shall be operator selectable.

3. Backup program shall provide manual operation from any PC on the LAN and shall operate while system remains operational.

D. Operator Passwords:

1. Support up to 32,000 individual system operators, each with a unique password.

2. One to eight alphanumeric characters.

3. Allow passwords to be case sensitive.

4. Passwords shall not be displayed when entered.

5. Passwords shall have unique and customizable password profile, and allow several operators to share a password profile. Include the following features in the password profile:

   a. Predetermine the highest-level password profile for access to all functions and areas of program.
b. Allow or disallow operator access to any program operation, including the functions of View, Add, Edit, and Delete.
c. Restrict doors to which an operator can assign access.

6. Operators shall use a user name and password to log on to system. This user name and password shall be used to access database areas and programs as determined by the associated profile.

7. Make provision to allow the operator to log off without fully exiting program. User may be logged off but program will remain running while displaying the login window for the next operator.

E. Access Card/Code Operation and Management: Access authorization shall be by card, by a manually entered code (PIN), or by a combination of both (card plus PIN).

1. Access authorization shall verify the facility code first, the card or card-and-PIN validation second, and the access level (time of day, day of week, date), anti-passback status, and number of uses last.
2. Use data-entry windows to view, edit, and issue access levels. Access-authorization entry-management system shall maintain and coordinate all access levels to prevent duplication or the incorrect creation of levels.
3. Allow assignment of multiple cards/codes to a cardholder.
4. Allow assignment of up to four access levels for each Location to a cardholder. Each access level may contain any combination of doors.
5. Each door may be assigned four time zones.
6. Access codes may be up to 11 digits in length.
7. Software shall allow the grouping of locations so cardholder data can be shared by all locations in the group.
8. Visitor Access: Issue a visitor badge for data tracking or photo ID purposes without assigning that person a card or code.
9. Cardholder Tracing: Allow for selection of cardholder for tracing. Make a special audible and visible annunciation at control station when a selected card or code is used at a designated code reader. Annunciation shall include an automatic display of the cardholder image.
10. Allow each cardholder to be given either an unlimited number of uses or a number from one to 9999 that regulates the number of times the card can be used before it is automatically deactivated.
11. Provide for cards and codes to be activated and deactivated manually or automatically by date. Provide for multiple deactivate dates to be preprogrammed.

F. Security Access Integration:

1. Photo ID badging and photo verification shall use the same database as the security access and may query data from cardholder, group, and other personal information to build a custom ID badge.
2. Automatic or manual image recall and manual access based on photo verification shall also be a means of access verification and entry.
3. System shall allow sorting of cardholders together by group or other characteristic for a fast and efficient method of reporting on, and enabling or disabling, cards or codes.

G. Key control and tracking shall be an integrated function of cardholder data.
1. Provide the ability to store information about which conventional metal keys are issued and to whom, along with key construction information.
2. Reports shall be designed to list everyone who possesses a specified key.

H. Facility Codes: System shall accommodate up to 2048 facility codes per Location, with the option of allowing facility codes to work at all doors or only at particular doors.

I. Operator Comments:

1. With the press of one appropriate button on the toolbar, the user shall be permitted to enter operator comments into the history at any time.
2. Automatic prompting of operator comment shall occur before the resolution of each alarm.
3. Operator comments shall be recorded by time, date, and operator number.
4. Comments shall be sorted and viewed through reports and history.
5. The operator may enter comments in two ways; either or both may be used:
   a. Manually entered through keyboard data entry (typed), up to 65,000 characters per each alarm.
   b. Predefined and stored in database for retrieval on request.

6. System shall have a minimum of 999 predefined operator comments with up to 30 characters per comment.

J. Group:

1. Group names may be used to sort cardholders into groups that allow the operator to determine the tenant, vendor, contractor, department, division, or any other designation of a group to which the person belongs.
2. System software shall have the capacity to assign one of 32,000 group names to an access authorization.
3. Make provision in software to deactivate and reactivate all access authorizations assigned to a particular group.
4. Allow sorting of history reports and code list printouts by group name.

K. Time Zones:

1. Each zone consists of a start and stop time for seven days of the week and three holiday schedules. A time zone is assigned to inputs, outputs, or access levels to determine when an input shall automatically arm or disarm, when an output automatically opens or secures, or when access authorization assigned to an access level will be denied or granted.
2. Up to four time zones may be assigned to inputs and outputs to allow up to four arm or disarm periods per day or four lock or unlock periods per day; up to three holiday override schedules may be assigned to a time zone.
3. Data-entry window shall display a dynamically linked bar graph showing active and inactive times for each day and holiday, as start and stop times are entered or edited.
4. System shall have the capacity for 2048 time zones for each Location.

L. Holidays:
1. Three different holiday schedules may be assigned to a time zone. Holiday schedule consists of date in format MM/DD/YYYY and a description. When the holiday date matches the current date of the time zone, the holiday schedule replaces the time-zone schedule for that 24-hour period.

2. System shall have the capacity for 32,000 holidays.

3. Three separate holiday schedules may be applied to a time zone.

4. Holidays have an option to be designated as occurring on the designated date each year. These holidays remain in the system and will not be purged.

5. Holidays not designated to occur each year shall be automatically purged from the database after the date expires.

M. Access Levels:

1. System shall allow for the creation of up to 32,000 access levels.

2. One level shall be predefined as the Master Access Level. The Master Access Level shall work at all doors at all times and override any anti-passback.

3. System shall allow for access to be restricted to any area by reader and by time. Access levels shall determine when and where an identifier is authorized.

4. System shall be able to create multiple door and time-zone combinations under the same access level so that an Identifier may be valid during different time periods at different readers even if the readers are on the same controller.

N. User-Defined Fields:

1. System shall provide a minimum of 99 user-defined fields, each with up to 50 characters, for specific information about each credential holder.

2. System shall accommodate a title for each field; field length shall be 20 characters.

3. A "Required" option may be applied to each user-defined field that, when selected, forces the operator to enter data in the user-defined field before the credential can be saved.

4. A "Unique" option may be applied to each user-defined field that, when selected, will not allow duplicate data from different credential holders to be entered.

5. Data format option may be assigned to each user-defined field that will require the data to be entered with certain character types in specific spots in the field entry window.

6. A user-defined field, if selected, will define the field as a deactivate date. The selection shall automatically cause the data to be formatted with the Windows MM/DD/YYYY date format. The credential of the holder will be deactivated on that date.

7. A search function shall allow any one user-defined field or combination of user-defined fields to be searched to find the appropriate cardholder. The search function shall include a search for a character string.

8. System shall have the ability to print cardholders based on and organized by the user-defined fields.

O. Code Tracing:

1. System shall perform code tracing selectable by cardholder and by reader.

2. Any code may be designated as a "traced code" with no limit to how many codes can be traced.

3. Any reader may be designated as a "trace reader" with no limit to which or how many readers can be used for code tracing.

4. When a traced code is used at a trace reader, the access-granted message that usually appears on the monitor window of the central station shall be highlighted with a different
color than regular messages. A short singular beep shall occur at the same time the highlighted message is displayed on the window.

5. The traced cardholder image (if image exists) shall appear on workstations when used at a trace reader.

2.6 SURGE AND TAMPER PROTECTION

A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.


B. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display shall identify tamper alarms and indicate locations.

2.7 CENTRAL-STATION HARDWARE

A. Central-Station Computer: Standard unmodified PC of modular design. The CPU word size shall be 32 bytes or larger; the CPU operating speed shall be at least 66 MHz.

1. Memory: 256 MB of usable installed memory, expandable to a minimum of 1024 MB without additional chassis or power supplies.

2. Power Supply: Minimum capacity of 250 W.

3. Real-Time Clock:

   a. Accuracy: Plus or minus one minute per month.
   b. Time-Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; resetttable by software.
   c. Clock shall function for one year without power.
   d. Provide automatic time correction once every 24 hours by synchronizing clock with the Time Service Department of the U.S. Naval Observatory.

4. Serial Ports: Provide two TIA 232-F serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.

5. Parallel Port: An enhanced parallel port.

6. LAN Adapter Card: 10/100 Mbps PCI bus, internal network interface card.

7. Sound Card: For playback and recording of digital WAV sound files that are associated with audible warning and alarm functions.

8. Color Monitor: Not less than 17 inches (430 mm) with a minimum resolution of 1280 by 1024 pixels, noninterlaced, and a maximum dot pitch of 0.28mm. The video card shall
support at least 256 colors at a resolution of 1280 by 1024 at a minimum refresh rate of 70 Hz.


10. Mouse: Standard, compatible with the installed software.

11. Special-function keyboard attachments or special-function keys to facilitate data input of the following operator tasks:

   a. Help.
   b. Alarm Acknowledge.
   c. Place Zone in Access.
   d. Place Zone in Secure.
   e. System Test.
   f. Print Reports.
   g. Change Operator.

12. Disk storage shall include the following, each with appropriate controller:

   a. Minimum 10GB hard disk, maximum average access time of 10ms.
   b. Floppy Disk Drive: High density, 3-1/2-inch (90-mm) size.
   c. PCMCIA slot with removable 500MB media.
   d. 100MB Iomega Zip drive.
   e. 250MB Iomega Jaz drive.

13. Magnetic Tape System: 4-mm cartridge magnetic tape system with minimum 4GB formatted capacity per tape. Provide 10 tapes, each in a rigid cartridge with spring-loaded cover and operator-settable write-protect feature.

14. Modem: 56,600 bps, full duplex for asynchronous communications. With error detection, auto answer/autodial, and call-in-progress detection. Modem shall comply with requirements in ITU-T V.34, ITU-T V.42 for error correction, and ITU-T V.42 BIS for data compression standards; and shall be suitable for operating on unconditioned voice-grade telephone lines complying with 47 CFR 68.


16. CD-ROM Drive:

   a. Nominal storage capacity of 650MB.
   b. Data Transfer Rate: 1.2Mbps.
   c. Average Access Time: 150ms.
   d. Cache Memory: 256KB.
   e. Data Throughput: 1MB/second, minimum.

17. Dot Matrix Alarm Printer:

   a. Connected to the central station.
   b. Minimum of 96 characters, standard ASCII character set based on ANSI INCITS 154, and with graphics capability and programmable top-of-form control.
   c. Prints in both red and black without ribbon change.
   d. Adjustable sprockets for paper width up to 11 inches.
   e. 80 columns per line, minimum speed of 200 characters per second.
   f. Character Spacing: Selectable at 10, 12, or 17 characters per inch.
   g. Paper: Sprocket-fed fan fold paper.
18. Report Printer:
   a. Connected to the central station and designated workstations.
   b. Laser printer with minimum resolution of 600 dpl.
   c. RAM: 2MB, minimum.
   d. Printing Speed: Minimum 12 pages per minute.


20. LAN Adapter Card: 10/100Mbps internal network interface card.

B. Redundant Central Computer: One identical redundant central computer, connected in a hot standby, peer configuration. This computer shall automatically maintain its own copies of system software, application software, and data files. System transactions and other activities that alter system data files shall be updated to system files of redundant computer in near real time. If central computer fails, redundant computer shall assume control immediately and automatically.

C. UPS: Self-contained; complying with requirements in Section 263353 "Static Uninterruptible Power Supply."

1. Size: Provide a minimum of six hours of operation of the central-station equipment, including two hours of alarm printer operation.
3. Accessories:
   a. SPD.
   b. Input-harmonics reduction.
   c. Rectifier/charger.
   d. Battery disconnect device.
   e. Static bypass transfer switch.
   f. Internal maintenance bypass/isolation switch.
   g. External maintenance bypass/isolation switch.
   h. Output isolation transformer.
   i. Remote UPS monitoring.
   j. Battery monitoring.
   k. Remote battery monitoring.

2.8 STANDARD WORKSTATION HARDWARE

A. Workstation shall consist of a standard unmodified PC with accessories and peripherals that configure the workstation for a specific duty.

B. Workstation Computer: Standard unmodified PC of modular design. The CPU word size shall be 32 bytes or larger; the CPU operating speed shall be at least 66 MHz.

1. Memory: 512MB of usable installed memory, expandable to a minimum of 8GB without additional chassis or power supplies.
2. Power Supply: Minimum capacity of 250W.
3. Real-Time Clock:
a. Accuracy: Plus or minus one minute per month.
b. Time-Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; resettable by software.
c. Provide automatic time correction once every 24 hours by synchronizing clock with the central station.

4. Serial Ports: Provide two TIA 232-F USB serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.

5. Parallel Port: An enhanced parallel port.

6. Sound Card: For playback and recording of digital WMP sound files that are associated with audible warning and alarm functions.

7. Color Monitor: Not less than 17 inches (430 mm) with a minimum resolution of 1280 by 1024 pixels, noninterlaced, and a maximum dot pitch of 0.28mm. The video card shall support at least 256 colors at a resolution of 1280 by 1024 at a minimum refresh rate of 70Hz.


9. Mouse: Standard, compatible with the installed software. Minimum resolution shall be 400 dpi.

10. Disk storage shall include the following, each with appropriate controller:

   a. Minimum 20GB hard disk, maximum average access time of 10ms.
   b. Floppy Disk Drive: High density, 3-1/2-inch (90-mm) size.

11. CD-ROM/CD-RW Drive:

   a. Nominal Storage Capacity: 700MB.
   b. Data Transfer Rate: 3.6Mbps.
   c. Average Access Time: 150ms.
   d. Cache Memory: 512KB.
   e. Data Throughput: 3.6MB/second, minimum.
   f. Read Speed: 48x.
   g. Write Speed: 32x.

12. DVD/DVD-RW Drive:

   a. Nominal Storage Capacity: 4.7GB.
   b. Data Transfer Rate: 3.6 Mbps.
   c. Cache Memory: 512 KB.
   d. Read Speed: 24x.
   e. Write Speed: 6x.

13. Printer:

   a. Connected to the central station and designated workstations.
   b. Laser printer with minimum resolution of 600 dpi.
   c. RAM: 8MB, minimum.
   d. Printing Speed: Minimum 12 pages per minute.

15. LAN Adapter Card: 10/100Mbps internal network interface card.

C. Redundant Workstation: One identical redundant workstation, connected in a hot standby, peer configuration. This workstation shall automatically maintain its own copies of system software, application software, and data files. System transactions and other activities that alter system data files shall be updated to system files of redundant workstation in near real time. If its associated workstation fails, redundant workstation shall assume control immediately and automatically.

D. UPS: Self-contained, complying with requirements in Section 263353 "Static Uninterruptible Power Supply."

1. Size: Provide a minimum of six hours of operation of the central-station equipment, including two hours of alarm printer operation.
3. Accessories:
   a. SPD.
   b. Input-harmonics reduction.
   c. Rectifier/charger.
   d. Battery disconnect device.
   e. Static bypass transfer switch.
   f. Internal maintenance bypass/isolation switch.
   g. External maintenance bypass/isolation switch.
   h. Output isolation transformer.
   i. Remote UPS monitoring.
   j. Battery monitoring.
   k. UPS operation monitoring.
   l. Abnormal operation. Visible and audible indication.
   m. Remote battery monitoring.

2.9 FIXED MAP DISPLAY

A. A fixed map display shall show layout of the protected facilities. Zones corresponding to those monitored by the system shall be highlighted on the display. Status of each zone shall be displayed using digital displays as required within each designated zone. A digital display test switch shall be provided on the map display.

2.10 CONTROLLERS

A. Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the central station or workstation for controlling its operation.

B. Subject to compliance with requirements in this article, manufacturers may use multipurpose controllers.

C. Battery Backup: Sealed, lead acid; sized to provide run time during a power outage of 90 minutes, complying with UL 924.
D. Alarm Annunciation Controller:

1. The controller shall automatically restore communication within 10 seconds after an interruption with the field device network.
   a. Inputs: Monitor dry contacts for changes of state that reflect alarm conditions. Provides at least eight alarm inputs, which are suitable for wiring as normally open or normally closed contacts for alarm conditions.
   b. Alarm-Line Supervision:
      1) Supervise the alarm lines by monitoring each circuit for changes or disturbances in the signal using dc change measurements. System shall initiate an alarm in response to an abnormal current, which is a dc change of 10 percent or more for longer than 500 ms.
      2) Transmit alarm-line-supervision alarm to the central station during the next interrogation cycle after the abnormal current condition.
   c. Outputs: Managed by central-station software.


E. Entry-Control Controller:

1. Function: Provide local entry-control functions including one- and two-way communications with access-control devices such as card readers, keypads, biometric personnel identity-verification devices, door strikes, magnetic latches, gate and door operators, and exit push buttons.
   a. Operate as a stand-alone portal controller using the downloaded database during periods of communication loss between the controller and the field-device network.
   b. Accept information generated by the entry-control devices; automatically process this information to determine valid identification of the individual present at the portal:
      1) On authentication of the credentials or information presented, check privileges of the identified individual, allowing only those actions granted as privileges.
      2) Privileges shall include, but are not limited to, time of day control, day of week control, group control, and visitor escort control.
   c. Maintain a date-, time-, and Location-stamped record of each transaction. A transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.

2. Inputs:
   a. Data from entry-control devices; use this input to change modes between access and secure.
   b. Database downloads and updates from the central station that include enrollment and privilege information.
3. Outputs:
   a. Indicate success or failure of attempts to use entry-control devices and make comparisons of presented information with stored identification information.
   b. Grant or deny entry by sending control signals to portal-control devices.
   c. Maintain a date-, time-, and Location-stamped record of each transaction and transmit transaction records to the central station.
   d. Door Prop Alarm: If a portal is held open for longer than 20 seconds alarm sounds.

4. With power supplies sufficient to power at voltage and frequency required for field devices and portal-control devices.

5. Data Line Problems: For periods of loss of communication with the central station, or when data transmission is degraded and generating continuous checksum errors, the controller shall continue to control entry by accepting identifying information, making authentication decisions, checking privileges, and controlling portal-control devices.
   a. Store up to 1000 transactions during periods of communication loss between the controller and access-control devices for subsequent upload to the central station on restoration of communication.

6. Controller Power: NFPA 70, Class II power-supply transformer, with 12- or 24-V ac secondary, backup battery and charger.
   a. Backup Battery: Premium, valve regulated, recombinant-sealed, lead-calcium battery; spill proof; with a full one-year warranty and a pro rata 9-year warranty. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
   b. Backup Battery: Valve-regulated, recombinant-sealed, lead-acid battery; spill proof. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
   c. Backup Power-Supply Capacity: 90 minutes of battery supply. Submit battery and charger calculations.
   d. Power Monitoring: Provide manual, dynamic battery-load test, initiated and monitored at the control center; with automatic disconnection of the controller when battery voltage drops below controller limits. Report by using local controller-mounted digital displays and by communicating status to central station. Indicate normal power on and battery charger on trickle charge. Indicate and report the following:
      1) Trouble Alarm: Normal power-off load assumed by battery.
      2) Trouble Alarm: Low battery.
      3) Alarm: Power off.

2.11 SECONDARY ALARM ANNUNCIATOR

A. Secondary Alarm Annunciation Site: A workstation with limited I/O capacity, consisting of a secondary alarm annunciation workstation to allow the operator to duplicate functions of the main operator interface and to show system status changes.
2.12 CARD READERS, CREDENTIAL CARDS, AND KEYPADS

A. Card-Reader Power: Powered from its associated controller, including its standby power source, and shall not dissipate more than 5 W.

B. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the controller. Response time shall be 800 ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.

C. Enclosure: Suitable for surface, semi-flush, pedestal, or weatherproof mounting. Mounting types shall additionally be suitable for installation in the following locations:
   1. Indoors, controlled environment.
   2. Indoors, uncontrolled environment.
   3. Outdoors, with built-in heaters or other cold-weather equipment to extend the operating temperature range as needed for operation at the site.

D. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.

E. Stripe Swipe Readers: Bidirectional, reading cards swiped in both directions, powered by the controller. Reader shall be set up for ABA Track.
   1. ABA Track: Magnetic stripe that is encoded on track 2, at 75-bpi density in binary-coded decimal format; for example, 5-bit, 16-character set.
   2. Readers for outdoors shall be in a polymeric plastic enclosure with all electronics potted in plastic. Rated for operation in ambient conditions of minus 40 to plus 160 deg F (minus 40 to plus 70 deg C) in a humidity range of 10 to 90 percent.

F. Wiegand Swipe Reader: Set up for 33-bit data cards. Comply with SIA AC-01.

G. Wiegand Key-Insert Reader: Set up for 33-bit data cards.


I. Insert Readers: Requiring the card to be inserted from the bottom, powered by the controller.

J. Touch-Plate and Proximity Readers:
   1. Active-detection proximity card readers shall provide power to compatible credential cards through magnetic induction, and shall receive and decode a unique identification code number transmitted from the credential card.
   2. Passive-detection proximity card readers shall use a swept-frequency, RF field generator to read the resonant frequencies of tuned circuits laminated into compatible credential cards. The resonant frequencies read shall constitute a unique identification code number.
   3. The card reader shall read proximity cards in a range from direct contact to at least 6 inches (150 mm) from the reader.

K. Keypads:
1. Entry-control keypads shall use a unique combination of alphanumeric and other symbols as an identifier.
2. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged in ascending ASCII-code ordinal sequence.
3. Communication protocol shall be compatible with the local processor.

L. Keypad Display:
   1. Keypads shall include a digital visual indicator and shall provide visible and audible status indications and user prompts.
   2. Display shall indicate power on or off and whether user passage requests have been accepted or rejected.
   3. Design of the keypad display or keypad enclosure shall limit viewing angles of the keypad as follows:
      a. Maximum Horizontal Viewing Angle: Plus or minus 5 degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display.
      b. Maximum Vertical Viewing Angle: Plus or minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.

M. Keypad Response Time:
   1. The keypad shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 ms or less from the time the last alphanumeric symbol is entered until a response signal is generated.

N. Keypad Power:
   1. The keypad shall be powered from the source as shown and shall not dissipate more than 150 W.

O. Keypad Mounting Method:
   1. Keypads shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.

P. Keypad Duesess Codes:
   1. Keypads shall provide a means for users to indicate a duesess situation by entering a special code.

Q. Keypad and Wiegand-Swipe-Reader Combination: Designed to require an entry on the keypad before presenting the credential.
   1. Keypad: Allow the entry of four numeric digits that are associated with a specific credential. Keypads shall contain an integral alphanumeric/special symbol keyboard with symbols arranged in ascending ASCII-code ordinal sequence Keypad display or enclosure shall limit viewing angles of the keypad as follows:
      a. Maximum Horizontal Viewing Angle: Plus or minus 5 degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display.
b. Maximum Vertical Viewing Angle: Plus or minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.

2. Wiegand Swipe Reader: Set up for 33-bit data cards to generate a unique card identification code. Comply with SIA AC-01.

R. Communication Protocol: Compatible with local processor.

S. Touch-Plate and Contactless Card Reader: The reader shall have "flash" download capability to accommodate card format changes. The card reader shall have capability of transmitting data to security control panel and shall comply with ISO/IEC 7816.

T. Credential Card Modification: Entry-control cards shall be able to be modified by lamination direct print process during the enrollment process without reduction of readability. The design of the credential cards shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the badge holder used at the site.

U. Card Size and Dimensional Stability: Credential cards shall be 2-1/8 by 3-3/8 inches (54 by 86 mm) The credential card material shall be dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.

V. Card Material: Abrasion resistant, nonflammable, nontoxic, and impervious to solar radiation and effects of ultraviolet light.

W. Card Construction:

1. Core and laminate or monolithic construction.
2. Lettering, logos, and other markings shall be hot stamped into the credential material or direct printed.
3. Incorporate holographic images as a security enhancement.
4. Furnish equipment for on-site assembly and lamination of credential cards.

2.13 BIOMETRIC IDENTIFICATION-VERIFICATION EQUIPMENT

A. Biometric identity-verification templates shall be stored as part of system database files and used as a comparative base by the identity-verification equipment to generate an appropriate signal to the associated controller.

B. Eye Retina Scanner: Designed to incorporate positive measures to establish that the eye retina being scanned by the device belongs to a living human being.

1. Retina scan device shall provide a means that does not require facial contact with the device for enrollees to align their eye for identification. A manual push button shall be provided to initiate the scan process when the enrollee's eye is aligned in front of the device.
2. The efficiency and accuracy of scanner shall not be affected by contact lenses.
3. Storage space for each eye template shall not exceed 512 8-bit bytes.
4. Light-emitting source used for retina scans may not use light levels exceeding 20 percent of the maximum safe level established in the American Conference of Governmental Industrial Hygienists limit values.
5. Template Update: Eye scanner shall not automatically update an enrollee's template. Significant changes in an individual's eye shall require re-enrollment.

6. Scan acceptance tolerance or template match criteria shall be under system manager/operator control. Eye scanner shall determine when multiple attempts are needed for retina verification and shall automatically prompt the enrollee for additional attempts up to a maximum of three. Three failed attempts shall generate an entry-control alarm.

7. Average Verification Time: Eye scanner shall respond to passage requests by generating an entry request signal to the controller. The verification time shall be 1.5 seconds or less from the moment eye scanner initiates the scan process until eye scanner generates a response signal.

8. Modes: Eye scanner shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.
   
   a. In the enrollment mode, eye scanner shall create an eye template for new personnel and enter the template into the system database file created for that person. Template information shall be compatible with system application software.
   
   b. In the recognition mode, eye scanner shall allow passage when the eye scan data from the verification attempt match an eye template stored in database files.
   
   c. In the code/credential verification mode, eye scanner shall allow passage when the eye scan data from the verification attempt match the eye scan template associated with the identification code entered into a keypad, or they match the eye scan template associated with credit card data read by a card reader.

9. Reports: Eye scanner shall create and store template match scores for all transactions involving eye retinal scans. Template match scores shall be stored in the matching personnel data file used for report generation.

10. Power: Scanner shall be powered from its associated controller, requiring not more than 45 W.

11. Enclosure: Eye scanners shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:
   
   a. Indoors, controlled environment.
   
   b. Indoors, uncontrolled environment.

12. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off and whether user passage requests have been accepted or rejected.

C. Hand Geometry: Use unique human hand measurements to identify authorized, enrolled personnel. The design of this device shall incorporate positive measures to establish that the hand being measured by the device belongs to a living human being.

1. The user's hand shall remain in full view of the user at all times. The scan process of the hand geometry device shall make three-dimensional measurements of the size and shape of the subject's hand. Scanning shall start automatically once the user's hand is properly positioned by the alignment system.

2. Hand geometry device shall be able to use either left or right hand for enrollment and verification.

3. Storage space for each hand template shall not exceed 50 8-bit bytes.
4. Template Update and Acceptance Tolerances: Hand geometry devices shall not automatically update a user's profile. Significant changes in an individual's hand geometry shall require re-enrollment. Hand geometry devices shall provide an adjustable acceptance tolerance or template match criteria under system manager/operator control. Hand geometry device shall determine when multiple attempts are needed for hand geometry verification and shall automatically prompt the user for additional attempts up to a maximum of three. Three failed attempts shall generate an entry-control alarm.

5. Average Verification Time: Hand geometry device shall respond to passage requests by generating an entry request signal to the controller. The verification time shall be 1.5 seconds or less from the moment hand geometry device initiates the scan process until hand geometry device generates a response signal.

6. Modes: Hand geometry device shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.
   a. In the enrollment mode, hand geometry device shall create a hand template for new personnel and enter the template into the system database file created for that person. Template information shall be compatible with system application software.
   b. In the recognition mode, hand geometry device shall allow passage when the hand scan data from the verification attempt match a hand geometry template stored in database files.
   c. In the code/credential verification mode, hand geometry device shall allow passage when the hand scan data from the verification attempt match the hand geometry template associated with the identification code entered into a keypad, or they match the hand geometry template associated with credential card data read by a card reader.

7. Reports: Hand geometry device shall create and store template match scores for all transactions involving hand geometry scans. Template match scores shall be stored in the matching personnel data file used for report generation.

8. Power: Hand geometry device shall be powered from its associated controller, requiring not more than 45W.

9. Enclosure: Geometry readers shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:
   a. Indoors, controlled environment.
   b. Indoors, uncontrolled environment.
   c. Outdoors.

10. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off and whether user passage requests have been accepted or rejected.

D. Fingerprint Analysis Scanner: Use a unique human fingerprint pattern to identify authorized, enrolled personnel. The design of this device shall incorporate positive measures to establish that the hand or fingers being scanned by the device belong to a living human being.

1. The user's hand shall remain in full view of the user at all times. The scan process of the fingerprint analysis scanner shall perform an optical or other type of scan of the enrollee's fingers. Scanning shall start automatically when the user's fingers are properly positioned.
2. Storage space for each fingerprint template shall not exceed 1250 8-bit bytes.

3. Template Update and Acceptance Tolerances: Fingerprint analysis scanners shall not automatically update an enrollee's profile. Significant changes in an individual's fingerprints shall require re-enrollment. Fingerprint analysis scanners shall provide an adjustable acceptance tolerance or template match criteria under system manager/operator control. Fingerprint analysis scanner shall determine when multiple attempts are needed for fingerprint verification and shall automatically prompt the user for additional attempts up to a maximum of three. Three failed attempts shall generate an entry-control alarm.

4. Average Verification Time: Fingerprint analysis scanner shall respond to passage requests by generating an entry request signal to the controller. The verification time shall be two seconds or less from the moment fingerprint analysis scanner initiates the scan process until fingerprint analysis scanner generates a response signal.

5. Modes: Fingerprint analysis scanner shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.
   
a. In the enrollment mode, fingerprint analysis scanner shall create a fingerprint template for new personnel and enter the template into the system database file created for that person.

b. In the recognition mode, fingerprint analysis scanner shall allow passage when the fingerprint data from the verification attempt match a fingerprint template stored in database files.

c. In the code/credential verification mode, fingerprint analysis scanner shall allow passage when the fingerprint data from the verification attempt match the fingerprint template associated with the identification code entered into a keypad, or they match the fingerprint template associated with credential card data read by a card reader.

6. Reports: Fingerprint analysis device shall create and store pattern match scores for all transactions involving fingerprint scans. Template match scores shall be stored in the matching personnel data file used for report generation.

7. Power: Fingerprint analysis scanner shall be powered from its associated controller, requiring not more than 45W.

8. Enclosure: Scanners shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:
   
a. Indoors, controlled environment.

   b. Indoors, uncontrolled environment.

   c. Outdoors.

9. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off and whether user passage requests have been accepted or rejected.

E. Iris Scan Device: Use the unique patterns found in the iris of the human eye to identify authorized, enrolled personnel. The device shall use ambient light to capture an image of the iris of a person for identification. The resulting video image shall be compared against a stored template that was captured during the enrollment process. When the presented image is sufficiently similar to the stored image template, then the device shall authenticate the presenting individual as identified. The threshold of similarity shall be adjustable.
1. The efficiency and accuracy of the device shall not be affected by contact lenses or eyeglasses.
2. Iris scan device shall provide a means that does not require facial contact with the device for enrollees to align their eye for identification. A manual push button shall be provided to initiate the scan process when the user's eye is aligned in front of the device.
3. The device shall include adjustments to accommodate differences in enrollee height.
4. Template Update: Iris scanners shall not automatically update an enrollee's template. Significant changes in an individual's eye shall require re-enrollment.
5. Scan acceptance tolerance or template match criteria shall be under system manager/operator control. Iris scanner shall determine when multiple attempts are needed for iris verification and shall automatically prompt the user for additional attempts up to a maximum of three. Three failed attempts shall generate an entry-control alarm.
6. Average Verification Time: Iris scanner shall respond to passage requests by generating an entry request signal to the controller. The verification time shall be 1.5 seconds or less from the moment iris scanner initiates the scan process until iris scanner generates a response signal.
7. Modes: Iris scanner shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.
   a. In the enrollment mode, iris scanner shall create an iris template for new personnel and enter the template into the system database file created for that person. Template information shall be compatible with system application software.
   b. In the recognition mode, iris scanner shall allow passage when the iris scan data from the verification attempt match an iris template stored in database files.
   c. In the code/credential verification mode, iris scanner shall allow passage when the iris scan data from the verification attempt match the iris scan template associated with the identification code entered into a keypad, or they match the iris scan template associated with credential card data read by a card reader.
8. Reports: Iris imaging shall create and store template match scores for all transactions involving iris scans. Template match scores shall be stored in the matching personnel data file used for report generation.
9. Power: Iris scanner shall be powered from its associated controller, requiring not more than 45W.
10. Enclosure: Eye scanners shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:
    a. Indoors, controlled environment.
    b. Indoors, uncontrolled environment.
11. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off and whether user passage requests have been accepted or rejected.

2.14 ENROLLMENT CENTER

A. Equipment for enrolling personnel into, and removing personnel from, system database, using central-station equipment.

1. Include equipment to enroll selected biometric credentials.
B. Enrollment equipment shall support encoding of credential cards including cryptographic and other internal security checks as required for system.

1. Allow only authorized entry-control enrollment personnel to access the enrollment equipment using passwords.
2. Include enrollment-subsystem configuration controls and electronic diagnostic aids for subsystem setup and troubleshooting with the central station.
3. Enrollment-station records printer shall meet requirements of the report printer.

C. Entry-Control Enrollment Software:

1. Shall include database management functions for the system, and shall allow an operator to change and modify the data entered in the system as needed.
2. Software shall not have alarm response or acknowledgment functions as a programmable function.
3. Multiple, password-protected access levels shall be provided at the enrollment station.
4. Database management and modification functions shall require a higher operator-access level than personnel enrollment functions.
5. Software shall provide a means for disabling the enrollment station when it is unattended, to prevent unauthorized use.
6. Software shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations to include a credential unit in use at the installation.
7. In the case of personnel identity-verification subsystems, this data shall include biometric data.
8. Software shall allow entry of this data into the system database files through the use of simple menu selections and data fields. The data field names shall be customized to suit user and site needs.
9. Personnel identity-verification subsystems selected for use with the system shall fully support the enrollment function and shall be compatible with the entry-control database files.

D. Accessories:

1. Steel desk-type console, swivel chair on casters, and equipment racks.
2. Console and Equipment Racks: Comply with EIA/ECA-310-E.
3. Equipment, with the exception of the printers, shall be rack mounted in the console and equipment racks.
4. Storage Cabinet: Locking cabinet approximately 72 inches (1830 mm) high, 36 inches (915 mm) wide, and 24 inches (610 mm) deep, with three adjustable shelves and two storage racks for storage of disks, tapes, printouts, printer paper, ribbons, manuals, and other documentation.

E. System Capacity: Number of badges shall be limited only by hard disk space. Badge templates and images shall be in color, supporting the maximum color capability of Microsoft Windows.

F. Badge Configuration:

1. Software for badge template creation shall include a template consisting of background and predetermined locations of photographs, text objects and data fields for text, and barcode and biometric information. Include automatic sizing of data fields placed on a badge to compensate for names, which may otherwise be too large to fit in the area designated.
2. Allow different badge templates to be used for each department, tenant, or visitor.
3. As a setup option, templates shall be automatically selected for the badge, based on the group to which the credential holder is assigned. Allow the operator to override the automatic template selection and use a template chosen by the operator for creating a badge.
4. Setup shall determine which graphics and credential-holder information will be displayed and where on the card it will be placed. All data in the security access system, such as name, code, group, access level, and any of the 99 user-defined fields, shall be selectable, with the ability to place them anywhere on the card.
5. System shall include an importing, filing, and recall system of stored images and shapes that can be placed on the badge.
6. Allow multiple images on the same badge, including, but not limited to, bar codes, digital photos, and signatures.
7. Support transparent backgrounds so that image is only surrounded by the intended background and not by its immediate background.

G. Photo Imaging: Integral to security access.
   1. Import images from bitmap file formats, digital cameras, TWAIN cameras, or scanners. Allow image cropping and editing, WYSIWYG badge-building application, and badge print-preview and printing capabilities.
   2. System shall support multiple images stored for each credential holder, including signatures, portrait views, and profile views.

H. Text Objects: Badge configuration shall provide for creation of custom text as an object, allowing font selection, typing, scaling, and formatting of the text object. Formatting options shall include changing font, font size, text flow, and text alignment; bending or curving the text object into a circle or semicircle; applying 3-D effects; and applying predefined effects such as tilt, extrusion, or beveling. Text shall be placed and optionally automatically centered within any region of the badge layout.

I. Badges and Credential Cards:
   1. Badges are credential cards that do not contain data to be read by card readers.
   2. Credential cards shall store uniquely coded data used by card readers as an Identifier.
      a. Magnetic-Stripe Cards: Comply with ISO/IEC 7810, ISO/IEC 7811-1, ISO/IEC 7811-2, ISO/IEC 7811-6, and ISO/IEC 7811-7. Use single-layer magnetic tape material that is coated with a plastic, slick protective coat and affixed to the back of the credential card near the top.
      b. Wiegand Wire-Effect Cards: Ferromagnetic wires laminated into the credential card using binary digits specified for Wiegand readers to generate a unique credential card identification code.
      c. Proximity Cards: Use proximity detection without physical contact with the reader for proper operation.
   3. Allow entry-control card to be modified by lamination or direct print process during the enrollment process for use as a picture and identification badge without reduction of readability. The design shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the type of badge holder used at the site.
a. Card Size and Dimensional Stability: Standard size, 2-1/8 by 3-3/8 inches (54 by 86 mm); dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.

b. Card Material: Abrasion resistant, nonflammable, and nontoxic; and impervious to solar radiation and effects of ultraviolet light.

c. Card Construction: Core and laminate or monolithic construction. Lettering, logos, and other markings shall be hot stamped into the credential material or direct printed.

1) Incorporate holographic images as a security enhancement.
2) Furnish equipment for on-site assembly and lamination of credential cards.

d. Card Durability and Maintainability: Designed and constructed to yield a useful lifetime of at least five years or 5000 insertions or swipes, whichever results in a longer period of time. Allow credential cards to be cleaned by wiping with a sponge or cloth wetted with soap and water.

J. Card-Making Equipment: Consisting of a workstation, video camera, video-imaging equipment, and a printer.

1. Camera: NTSC color standard, RGB video output, 470 lines minimum horizontal resolution, and automatic white balance with full rated output under illumination of 0.5 fc (5 lx).

2. Video Imaging: Live-image capture software and hardware and a digital signature capture pad.

3. Standard workstation, modified as follows:

   a. Redundant workstation is not required.
   b. Printer is not required.
   c. UPS is not required.
   d. Sound card is not required.

4. Printer: Dye-sublimation resin thermal transfer, 300 dpi resolution, 16.7 million colors, accepting cards ranging in size from 2.1 by 3 inche to 2.6 by 3.7 inches (53 by 76 mm to 66 by 94 mm) and having card thickness ranging from 0.020 to 0.060 inch (0.5 to 1.5 mm). Printer shall have options for encoding magnetic stripe using tracks 1, 2, and 3. Throughput shall be not less than 60 seconds per card.

2.15 PUSH-BUTTON SWITCHES

A. Push-Button Switches: Momentary-contact back-lighted push buttons with stainless-steel switch enclosures.

B. Electrical Ratings:

1. Minimum continuous current rating of 10 A at 120-V ac or 5 A at 240-V ac.
2. Contacts that will make 720 VA at 60 A and that will break at 720 VA at 10 A.

C. Enclosures: Flush or surface mounting. Push buttons shall be suitable for flush mounting in the switch enclosures.
D. Enclosures shall additionally be suitable for installation in the following locations:
   1. Indoors, controlled environment.
   2. Indoors, uncontrolled environment.
   3. Outdoors.

E. Power: Push-button switches shall be powered from their associated controller, using dc control.

2.16 DOOR AND GATE HARDWARE INTERFACE

A. Exit Device with Alarm: Operation of the exit device shall generate an alarm and annunciate a local alarm. Exit device and alarm contacts are specified in Section 087100 "Door Hardware."

B. Exit Alarm: Operation of a monitored door shall generate an alarm. Exit devices and alarm contacts are specified in Section 087100 "Door Hardware."

C. Electric Door Strikes: Use end-of-line resistors to provide power-line supervision. Signal switches shall transmit data to controller to indicate when the bolt is not engaged and the strike mechanism is unlocked, and they shall report a forced entry. Power and signal shall be from the controller. Electric strikes are specified in Section 087100 "Door Hardware."

D. Electromagnetic Locks: End-of-line resistors shall provide power-line supervision. Lock status sensing signal shall positively indicate door is secure. Power and signal shall be from the controller. Electromagnetic locks are specified in Section 087100 "Door Hardware."

E. Vehicle Gate Operator: Interface electrical operation of gate with controls in this Section. Vehicle gate operators shall be connected, monitored, and controlled by the security access controllers. Vehicle gate and accessories are specified in Section 323113 "Chain Link Fences and Gates."

2.17 FIELD-PROCESSING SOFTWARE

A. Operating System:
   1. Local processors shall contain an operating system that controls and schedules that local processor's activities in real time.
   2. Local processor shall maintain a point database in its memory that includes parameters, constraints, and the latest value or status of all points connected to that local processor.
   3. Execution of local processor application programs shall utilize the data in memory resident files.
   4. Operating system shall include a real-time clock function that maintains the seconds, minutes, hours, date, and month, including day of the week.
   5. Local processor real-time clock shall be automatically synchronized with the central station at least once per day to plus or minus 10 seconds (the time synchronization shall be accomplished automatically, without operator action and without requiring system shutdown).

B. Startup Software:
1. Causes automatic commencement of operation without human intervention, including startup of all connected I/O functions.
2. Local processor restart program based on detection of power failure at the local processor shall be included in the local processor software.
4. Upon failure of the local processor, if the database and application software are no longer resident, the local processor shall not restart and systems shall remain in the failure mode indicated until the necessary repairs are made.
5. If the database and application programs are resident, the local processor shall immediately resume operation.

C. Operating Mode:

1. Local processors shall control and monitor inputs and outputs as specified, independent of communications with the central station or designated workstations.
2. Alarms, status changes, and other data shall be transmitted to the central station or designated workstations when communications circuits are operable.
3. If communications are not available, each local processor shall function in a stand-alone mode and operational data, including the status and alarm data normally transmitted to the central station or designated workstations, shall be stored for later transmission to the central station or designated workstations.
4. Storage for the latest 4000 events shall be provided at local processors, as a minimum.
5. Local processors shall accept software downloaded from the central station.
6. Panel shall support flash ROM technology to accomplish firmware downloads from a central location.

D. Failure Mode: Upon failure for any reason, each local processor shall perform an orderly shutdown and force all local processor outputs to a predetermined (failure-mode) state, consistent with the failure modes shown and the associated control device.

E. Functions:

1. Monitoring of inputs.
2. Control of outputs.
3. Reporting of alarms automatically to the central station.
4. Reporting of sensor and output status to central station upon request.
5. Maintenance of real time, automatically updated by the central station at least once a day.
6. Communication with the central station.
7. Execution of local processor resident programs.
8. Diagnostics.
9. Download and upload data to and from the central station.

2.18 FIELD-PROCESSING HARDWARE

A. Alarm Annunciation Local Processor:

1. Respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station, and change outputs based on commands received from the central station.
2. Local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs.

3. Local processor inputs shall monitor dry contacts for changes of state that reflect alarm conditions.

4. Local processor shall have at least eight alarm inputs which allow wiring contacts as normally open or normally closed for alarm conditions; and shall provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements.

5. Local processor shall report line supervision alarms to the central station.

6. Alarms shall be reported for any condition that remains abnormal at an input for longer than 500 milliseconds.

7. Alarm condition shall be transmitted to the central computer during the next interrogation cycle.

8. Local processor outputs shall reflect the state of commands issued by the central station.

9. Outputs shall be a form C contact and shall include normally open and normally closed contacts.

10. Local processor shall have at least four command outputs.

11. Local processor shall be able to communicate with the central station via RS-485 or TCP/IP as a minimum.

B. Processor Power Supply:

1. Local processor and sensors shall be powered from an uninterruptible power source.

2. Uninterruptible power source shall provide eight hours of battery back-up power in the event of primary power failure and shall automatically fully recharge the batteries within 12 hours after primary power is restored.

3. If the facility is without an emergency generator, the uninterruptible power source shall provide 24 hours of battery backup power.

4. There shall be no equipment malfunctions or perturbations or loss of data during the switch from primary to battery power and vice versa.

5. Batteries shall be sealed, non-outgassing type.

6. Power supply shall be equipped with an indicator for ac input power and an indicator for dc output power.

7. Loss of primary power shall be reported to the central station as an alarm.

C. Auxiliary Equipment Power: A GFI service outlet shall be furnished inside the local processor's enclosure.

D. Entry-Control Local Processor:

1. Entry-control local processor shall respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station, and change outputs based on commands received from the central station.

2. Local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs.

3. Entry-control local processor shall provide local entry-control functions including communicating with field devices such as card readers, keypads, biometric personnel identity-verification devices, door strikes, magnetic latches, gate and door operators, and exit push buttons.
4. Processor shall also accept data from entry-control field devices as well as database downloads and updates from the central station that include enrollment and privilege information.
5. Processor shall send indications of successful or failed attempts to use entry-control field devices and shall make comparisons of presented information with stored identification information.
6. Processor shall grant or deny entry by sending control signals to portal-control devices and mask intrusion-alarm annunciation from sensors stimulated by authorized entries.
7. Entry-control local processor shall use inputs from entry-control devices to change modes between access and secure.
8. Local processor shall maintain a date-time- and location-stamped record of each transaction and transmit transaction records to the central station.
9. Processor shall operate as a stand-alone portal controller using the downloaded database during periods of communication loss between the local processor and the central station.
10. Processor shall store a minimum of 4000 transactions during periods of communication loss between the local processor and the central station for subsequent upload to the central station upon restoration of communication.
11. Local processor inputs shall monitor dry contacts for changes of state that reflect alarm conditions.
12. Local processor shall have at least eight alarm inputs which allow wiring contacts as normally open or normally closed for alarm conditions; and shall also provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements.
13. Local processor shall report line supervision alarms to the central station.
14. Alarms shall be reported for any condition that remains abnormal at an input for longer than 500 ms.
15. Alarm condition shall be transmitted to the central station during the next interrogation cycle.
16. Entry-control local processor shall include the necessary software drivers to communicate with entry-control field devices. Information generated by the entry-control field devices shall be accepted by the local processor and automatically processed to determine valid identification of the individual present at the portal.
17. Upon authentication of the credentials or information presented, the local processor shall automatically check privileges of the identified individual, allowing only those actions granted as privileges.
18. Privileges shall include, but are not limited to, time of day control, day of week control, group control, and visitor escort control. The local processor shall maintain a date-time- and location-stamped record of each transaction.
19. Transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.
20. Local processor outputs shall reflect the state of commands issued by the central station.
21. Outputs shall be a form C contact and shall include normally open and normally closed contacts.
22. Local processor shall have at least four addressable outputs.
23. The entry-control local processor shall also provide control outputs to portal-control devices.
24. Local processor shall be able to communicate with the central station via RS-485 or TCP/IP as a minimum.
25. The system manufacturer shall provide strategies for downloading database information for panel configurations and cardholder data to minimize the required download time when using IP connectivity.
2.19 TIA 232-F ASCII INTERFACE SPECIFICATIONS

A. ASCII interface shall allow TIA 232-F connections to be made between the control station operating as the host PC and any equipment that will accept TIA 232-F ASCII command strings, such as CCTV switches, intercoms, and paging systems.

1. Alarm inputs in system shall allow for individual programming to output up to four unique ASCII character strings through two different COM ports on the host PC.
2. Inputs shall have the ability to be defined to transmit a unique ASCII string for alarm and one for restore through one COM port, and a unique ASCII string for a nonalarm, abnormal condition and one for a normal condition through the same or different COM port.
3. Predefined ASCII character strings shall have the ability to be up to 420 characters long with full use of all the ASCII control characters, such as return or line feed. Character strings shall be defined in the system database and then assigned to the appropriate inputs.
4. COM ports of the host PC used to interface with external equipment shall be defined in the setup portion of the software. COM port's baud rate, word length, stop bits, and parity shall be definable in the software to match that of the external equipment.

B. Pager-System Interface: Alarms shall be able to activate a pager system with customized message for each input alarm.

1. TIA 232-F output shall be capable of connection to a pager interface that can be used to call a paging system or service and send a signal to a portable pager. System shall allow an individual alphanumeric message per alarm input to be sent to the paging system. This interface shall support both numeric and alphanumeric pagers.

C. Alarm-System Interface:

1. TIA 232-F output shall be capable of transmitting alarms from other monitoring and alarm systems to central-station automation software.
2. Alternatively, alarms that are received by this access-control system are to be transferred to the alarm automation system as if they were sent through a digital alarm receiver.
   a. System shall be able to transmit an individual message from any alarm input to a burglar-alarm automation monitoring system.
   b. System shall be able to append to each message a predefined set of character strings as a prefix and a suffix.

2.20 FLOOR-SELECT ELEVATOR CONTROL

A. Elevator access control shall be integral to security access.

1. System shall be capable of providing full elevator security and control through dedicated controllers without relying on the control-station host PC for elevator control decisions.
2. Access-control system shall enable and disable car calls on each floor and floor-select buttons in each elevator car, restricting passengers' access to the floors where they have been given access.
3. System setup shall, through programming, automatically and individually secure and unsecure each floor-select button of a car by time and day. Each floor-select button
within a car shall be separately controlled so that some floors may be secure while others remain unsecure.

4. When a floor-select button is secure, it shall require the passenger to use his or her access code and gain access to that floor before the floor-select button will operate. The passenger's credential shall determine which car call and floor-select buttons are to be enabled, restricting access to floors unless authorized by the system's access code database. Floor-select button shall be enabled only in the car where the credential holder is the passenger.

B. Security access system shall record which call button is pressed, along with credential and time information.

1. System controller shall record elevator access data.
2. The controller shall reset all additional call buttons that may have been enabled by the user's credential.
3. The floor-select elevator control shall allow for manual override from a workstation PC either by individual floor or by cab.

2.21 REAL-TIME GUARD TOUR

A. Guard tour module shall provide the ability to plan, track, and route tours. Module shall input an alarm during tour if guard fails to make a station. Tours can be programmed for sequential or random tour-station order.

1. Guard tour setup shall define specific routes or tours for the guard to take, with time restrictions in which to reach every predefined tour station.
2. Guard tour activity shall be automatically logged to the central-station PC's hard drive.
3. If the guard is early or late to a tour station, a unique alarm per station shall appear at the central station to indicate the time and station.
4. Guard tour setup shall allow the tours to be executed sequentially or in a random order with an overall time limit set for the entire tour instead of individual times for each tour station.
5. Setup shall allow recording of predefined responses that will display for the operator at the control station should a "Failed to Check In" alarm occur.

B. Guard tour module shall allow proprietary direct-connected systems to use security access-control hardware to perform guard tour management in real time.

C. A tour station is a physical location where a guard shall go and perform an action indicating that he or she has arrived. This action, performed at the tour station, shall be one of 13 different events with any combination of station types within the same tour. An event at a tour station shall be one of the following types:

3. Access Denied Card plus PIN.
4. Access Denied Time Zone.
5. Access Denied Level.
10. Alarm.
11. Restored.
12. Input Normal.
13. Input Abnormal.

D. Guard tour and other system features shall operate simultaneously with no interference.

E. Guard Tour Module Capacity: 999 possible guard tour definitions with each tour having up to 99 tour stations. System shall allow all 999 tours to be running at the same time.

2.22 VIDEO AND CAMERA CONTROL

A. Control station or designated workstation displays live video from a CCTV source.

1. Control Buttons: On the display window, with separate control buttons to represent Left, Right, Up, Down, Zoom In, Zoom Out, Scan, and a minimum of two custom-command auxiliary controls.
2. Provide at least seven icons to represent different types of cameras, with ability to import custom icons. Provide option for display of icons on graphic maps to represent their physical location.
3. Provide the alarm-handling window with a command button that will display the camera associated with the alarm point.

B. Display mouse-selectable icons representing each camera source, to select source to be displayed. For CCTV sources that are connected to a video switcher, control station shall automatically send control commands through a COM port to display the requested camera when the camera icon is selected.

C. Allow cameras with preset positioning to be defined by displaying a different icon for each of the presets. Provide control with Next and Previous buttons to allow operator to cycle quickly through the preset positions.

2.23 CABLES

A. General Cable Requirements: Comply with requirements in Section 280513 "Conductors and Cables for Electronic Safety and Security" and as recommended by system manufacturer for integration requirement.

B. PVC-Jacketed, TIA 232-F Cables:

1. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum-foil/polyester-tape shielded pairs with 100 percent shield coverage; PVC jacket.
2. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
3. NFPA 70, Type CM.

C. Plenum-Type, TIA 232-F Cables:
1. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum-foil/polyester-tape shielded pairs with 100 percent shield coverage; plastic jacket.

2. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

3. NFPA 70, Type CMP.


D. PVC-Jacketed, TIA 485-A Cables: Two pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.

E. Plenum-Type, TIA 485-A Cables:

1. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket.

2. NFPA 70, Type CMP.


F. Multiconductor, PVC, Reader and Wiegand Keypad Cables:

1. No. 22 AWG, paired and twisted multiple conductors, stranded (7x30) tinned copper conductors, semirigid PVC insulation, overall aluminum-foil/polyester-tape shield with 100 percent shield coverage, plus tinned copper braid shield with 65 percent shield coverage, and PVC jacket.

2. NFPA 70, Type CMG.


4. For TIA 232-F applications.

G. Paired, PVC, Reader and Wiegand Keypad Cables:

1. Three pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, individual aluminum-foil/polyester-tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and PVC jacket.

2. NFPA 70, Type CM.


H. Paired, PVC, Reader and Wiegand Keypad Cables:

1. Three pairs, twisted, No. 20 AWG, stranded (7x28) tinned copper conductors, polyethylene (polyolefin) insulation, individual aluminum-foil/polyester-tape shielded pairs each with No. 22 AWG, stranded (19x34) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.

2. NFPA 70, Type CM.


I. Paired, Plenum-Type, Reader and Wiegand Keypad Cables:

1. Three pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, individual aluminum-foil/polypropylene-tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and fluorinated-ethylene-propylene jacket.
2. NFPA 70, Type CMP.

J. Multiconductor, Plenum-Type, Reader and Wiegand Keypad Cables:

1. Six conductors, No. 20 AWG, stranded (7x28) tinned copper conductors, fluorinated-ethylene-propylene insulation, overall aluminum-foil/polyester-tape shield with 100 percent shield coverage plus tinned copper braid shield with 85 percent shield coverage, and fluorinated-ethylene-propylene jacket.
2. NFPA 70, Type CMP.

K. Paired, Lock Cables:

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, un shielded, and PVC jacket.
2. NFPA 70, Type CMG.

L. Paired, Plenum-Type, Lock Cables:

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
2. NFPA 70, Type CMP.

M. Paired, Lock Cables:

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
2. NFPA 70, Type CMG.

N. Paired, Plenum-Type, Lock Cables:

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
2. NFPA 70, Type CMP.

O. Paired, Input Cables:

1. One pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, overall aluminum-foil/polyester-tape shield with No. 22 AWG, stranded (7x30) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
2. NFPA 70, Type CMR.

P. Paired, Plenum-Type, Input Cables:
1. One pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylenes-propylene insulation, aluminum-foil/polyester-tape shield (foil side out), with No. 22 AWG drain wire, 100 percent shield coverage, and plastic jacket.
2. NFPA 70, Type CMP.

Q. Paired, AC Transformer Cables:
1. One pair, twisted, No. 18 AWG, stranded (7x26) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
2. NFPA 70, Type CMG.

R. Paired, Plenum-Type, AC Transformer Cables:
1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
2. NFPA 70, Type CMP.

S. Elevator Travel Cables:
1. Steel center core with shielded, twisted pairs, No. 20 AWG conductor size.
2. Steel center core support shall be preformed, flexible, low-torsion, zinc-coated, steel wire rope; insulated with 60 deg C flame-resistant PVC and covered with a nylon or cotton braid.
3. Shielded pairs shall be insulated copper conductors; color-coded, insulated with 60 deg C flame-resistant PVC; each pair shielded with bare copper braid for 85 percent coverage.
4. Electrical grade, dry jute filler.
5. Helically wound synthetic fiber binder.
6. Rayon or cotton braid applied with 95 percent coverage.
7. 60 deg C PVC jacket specifically compounded for flexibility and abrasion resistance; and complying with UL VW-1 and CSA FT1 flame rated.

T. LAN Cabling:
1. Comply with requirements in Section 280513 "Conductors and Cables for Electronic Safety and Security."
2. NFPA 262.

2.24 TRANSFORMERS
A. NFPA 70, Class II control transformers, NRTL listed. Transformers for security access-control system shall not be shared with any other system.

2.25 CABLE AND ASSET MANAGEMENT SOFTWARE
A. Computer-based cable and asset management system, with fully integrated database and graphic capabilities, complying with requirements in TIA/EIA 606-A.
1. Document physical characteristics by recording the network, asset, user, TIA/EIA details, device configurations, and exact connections between equipment and cabling.
   
   a. Manage the physical layer of security system.
   b. List device configurations.
   c. List and display circuit connections.
   d. Record firestopping data.
   e. Record grounding and bonding connections and test data.

2. Information shall be presented in database view, schematic plans, or technical drawings.
   
   a. Microsoft Visio Technical Drawing shall be used as drawing and schematic plans software. Drawing symbols, system layout, and design shall comply with SIA/IAPSC AG-01.

3. System shall interface with the following testing and recording devices:
   
   a. Direct-upload tests from circuit testing instrument into the PC.
   b. Direct-download circuit labeling into labeling printer.

B. Software shall be designed for of the same version as security access system's central station and workstations and shall be installed on the designated PC, using a hard drive dedicated only to this management function.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for LAN and control cable conduit systems to PCs, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with recommendations in SIA CP-01.

B. Comply with TIA/EIA 606-A, "Administration Standard for Commercial Telecommunications Infrastructure."

C. Product Schedules: Obtain detailed product schedules from manufacturer of access-control system or develop product schedules to suit Project. Fill in all data available from Project plans and specifications and publish as Product Schedules for review and approval.
1. Record setup data for control station and workstations.
2. For each Location, record setup of controller features and access requirements.
3. Propose start and stop times for time zones and holidays, and match up access levels for doors.
4. Set up groups, facility codes, linking, and list inputs and outputs for each controller.
5. Assign action message names and compose messages.
6. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
7. Prepare and install alarm graphic maps.
8. Develop user-defined fields.
10. Propose setups for guard tours and key control.
11. Discuss badge layout options; design badges.
12. Complete system diagnostics and operation verification.
13. Prepare a specific plan for system testing, startup, and demonstration.
14. Develop acceptance test concept and, on approval, develop specifics of the test.
15. Develop cable and asset-management system details; input data from construction documents. Include system schematics and Visio Technical Drawings in electronic format.

D. In meetings with Architect and Owner, present Product Schedules and review, adjust, and prepare final setup documents. Use approved, final Product Schedules to set up system software.

3.3 CABLELING

A. Comply with NECA 1, "Good Workmanship in Electrical Construction."

B. Install cables and wiring according to requirements in Section 280513 "Conductors and Cables for Electronic Safety and Security."

C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

D. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental airspaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

E. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E rating of components and fiber-optic rating of components, and that ensure Category 6 and fiber-optic performance of completed and linked signal paths, end to end.

F. Boxes and enclosures containing security-system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.

G. Install end-of-line resistors at the field device location and not at the controller or panel location.
3.4 CABLE APPLICATION

A. Comply with TIA 569-B, "Commercial Building Standard for Telecommunications Pathways and Spaces."

B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.

C. TIA 232-F Cabling: Install at a maximum distance of 50 ft. (15 m).

D. TIA 485-A Cabling: Install at a maximum distance of 4000 ft. (1220 m).

E. Card Readers and Keypads:
   1. Install number of conductor pairs recommended by manufacturer for the functions specified.
   2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from controller to the reader is 250 ft. (75 m), and install No. 20 AWG wire if maximum distance is 500 ft. (150 m).
   3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the controller.
   4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.

F. Install minimum No. 16 AWG cable from controller to electrically powered locks. Do not exceed 250 ft. (75 m).

G. Install minimum No. 18 AWG ac power wire from transformer to controller, with a maximum distance of 25 ft. (8 m).

3.5 GROUNDING

A. Comply with Section 280526 "Grounding and Bonding for Electronic Safety and Security."

B. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."

C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

D. Bond shields and drain conductors to ground at only one point in each circuit.

E. Signal Ground:
   1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
   2. Bus: Mount on wall of main equipment room with standoff insulators.
   3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.
3.6 INSTALLATION

A. Push Buttons: Where multiple push buttons are housed within a single switch enclosure, they shall be stacked vertically with each push-button switch labeled with 1/4-inch- (6.4-mm-) high text and symbols as required. Push-button switches shall be connected to the controller associated with the portal to which they are applied, and shall operate the appropriate electric strike, electric bolt, or other facility release device.

B. Install card readers, keypads, push buttons, and biometric readers.

3.7 IDENTIFICATION

A. In addition to requirements in this article, comply with applicable requirements in Section 260553 "Identification for Electrical Systems" and with TIA/EIA 606-A.

B. Using software specified in "Cable and Asset Management Software" Article, develop cable administration drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with the same designation. Use logical and systematic designations for facility’s architectural arrangement.

C. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.

2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.

D. At completion, cable and asset management software shall reflect as-built conditions.

3.8 SYSTEM SOFTWARE AND HARDWARE

A. Develop, install, and test software and hardware, and perform database tests for the complete and proper operation of systems involved. Assign software license to Owner.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 5 tester. Test for faulty...
connectors, splices, and terminations. Test according to TIA/EIA 568-B.1, "Commercial Building Telecommunications Cabling Standards - Part 1: General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA 568-B.1.

2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power-supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.

3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

C. Devices and circuits will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 STARTUP SERVICE

A. Engage a factory-authorized service representative to supervise and assist with startup service.

1. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.

2. Enroll and prepare badges and access cards for Owner's operators, management, and security personnel.

3.11 PROTECTION

A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured with an activated burglar alarm and access-control system reporting to a central station complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.

3.12 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain security access system. See Section 017900 "Demonstration and Training."

B. Develop separate training modules for the following:

1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.

2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.


4. Hardware maintenance personnel.
END OF SECTION 281300
PART 1 GENERAL

1.1 DESCRIPTION

A. Work includes:

1. Furnish all labor, materials, tools, equipment and services for a complete supervised microprocessor controlled, intelligent reporting fire detection and alarm system consisting of a control panel, terminal cabinets, addressable initiating and signaling devices, conduit, boxes, wiring, annunciator panels, and other components as required for a functional system.

2. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, and complete installation.

3. System shall cover and correspond to existing and new fire zones as designated by University Representative.

4. All electrical connections needed between both new and existing equipment. The term "electrical connections" shall be taken to include all operations and materials associated with completing electrical connection starting with pulled in wire including, but not limited to:
   a. Stripping of jacket(s) and insulation.
   b. Checking for continuity.
   c. Meggering.
   d. Tracing of wire.
   e. Fanning.
   f. Measuring and cutting to final termination lengths.
   g. Installing wire permanent wire markers for identification of conductors.
   h. Installation of lugs, connectors or terminals.
   i. Fastening wire to designated terminal point or other designated point.
   j. Taping as required.

B. Related sections:

1. Electrical General Requirements: Section 26 00 10.

2. Low-Voltage Electrical Power Conductors and Cables: Section 26 05 19.

3. Hangers and Supports for Electrical Systems: Section 26 05 29.

4. Raceways and Boxes for Electrical Systems: Section 26 05 33.


7. See paragraph 2.04 G2.5 F, Intelligent Duct Smoke Detectors.

C. Description of system: Automatic and manual, addressable, analog, general alarm, supervised, 24 volt DC fire detection and alarm system. Fire alarm system is provided under Increment 2 Scope of Work. For Increment 3 Scope of Work provide device that is compatible with systems specified.

1. Provide non-coded positive non-interfering system.

D. Provide components as specified in the Fire Alarm Components Schedule including but not limited to following.
2. Automatic addressable heat detectors.
3. Automatic addressable smoke detectors with analog output.
4. Remote alarm indicator with test/reset switch for concealed smoke detectors/duct detectors. See Related Divisions 22.
5. Sprinkler and standpipe flow switch and main waterflow detector circuits.
7. Separate power supply with battery backup and circuiting to fire alarm activated door closers (24V).
8. Modules for interfacing contact closure devices to addressable system. Do not use interface modules to connect non-addressable manual stations to fire alarm system.
9. Synchronized flashing general alarm lights.
10. Combination audible and synchronized visual signal devices.
11. Fire alarm system conduit and wire.

1.2 QUALITY ASSURANCE

A. System standards:
   1. NFPA 90A.
   5. Factory Mutual FM approved.
   6. Approved by California State Fire Marshal and title 19.
   7. NFPA 101 Life Safety
   8. TITLE 24 Parts 2, 3, 7, 9, & 12.
   10. UL 38 Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems.
   11. UL 217 Single and Multiple Station Smoke Detectors.
   13. UL 464 Audible Signal Appliances.
   15. UL 632 Electrically Actuated Transmitters.
   16. UL 864 Control Units for Fire Protective Signaling Systems.
   17. UL 864 Control Units for Fire Protective Signaling Systems.
   18. NEMA SB-27 Signaling Apparatus.
   19. NEMA SB-9 Smoke Detectors
   20. NEMA ICS 1 Industrial Controls and Systems.
   21. NEMA ICS 4 terminal Blocks for Industrial Control Equipment and Systems.
   22. NEMA ICS 6 enclosure for Industrial Control and Systems.
   23. Other codes as required.

B. Design criteria:
   1. Comply with all system standards.
   2. Meet all requirements of fire authorities having jurisdiction.
   3. Complete fire detection and alarm system design, wiring diagrams, interphase wiring diagrams, and operational details by system manufacturer or authorized technical representative.
   4. System: All equipment shall be approved and listed by the California State Fire Marshal and UL.
5. Installation shall conform to the state and local Fire Marshal (UCDMC Fire Department) requirements and shall be subject to inspection by them.

6. Contractor approved for and installing the work shall have on staff Nicet minimum level 2 technicians & minimum Nicet level 4 designers.

7. Contractor installing shall be UL certified.

8. All components shall be the most current model manufactured.

C. As part of the scope of this work, the equipment manufacturer shall provide a full description of the scope of recommended system training necessary for the University's personnel. The scope of training should include training sequences available at the job site. The number of persons attending the system training courses shall be determined by the University. The training at the job site shall be provided prior to system approval by the University. Submit three (3) copies of certificate, signed by University, attesting to having been trained. System operating training shall be given by an experienced and competent manufacturer's representative familiar with the fire alarm system.

D. Qualifications for Contractor Installing Work:
   1. Offer an annual maintenance contract including complete service and equipment costs for maintenance of complete system.
   2. Five years experience minimum servicing Notifier fire alarm systems.
   3. Contractor installing fire alarm system must be an authorized Notifier NESCO distributor and shall show evidence upon request that they have installed systems of similar type and scope for a minimum of five years. Contractor shall show knowledge of working on NFS2-3030, NFS2-640, AM2020, AFP1010, AFP-200, Digital Voice, Onyxworks Notifier type systems.
   4. Provide for 24-hour emergency service.
   5. Notifier factory trained technicians.

1.3 GUARANTEE

A. The entire fire alarm system shall be warranted for a period of two years.

B. For all repairs that cannot be completed after the initial response, a written plan of correction shall be submitted to the University prior to leaving the premises.

C. Contractor shall provide warranty service furnished by the installing company. Response time for emergency service shall be no longer than two (2) hours from the time of notification. Response time for non-emergency service shall be no longer than twenty four (24) hours from the time of notification.

1.4 SUBMITTALS (SEE DIVISION 01)

A. Submit the following with shop drawings:
   1. Floor plans showing the entire project area, all fire alarm devices and conduit and wire runs. The room number and use must be indicated for all rooms or spaces. Label all fire alarm devices with device address, and label all conduit runs with the type, size and number of conductors with the conduit.
   2. The floor plan must indicate the location and type for all fire rated walls and partitions.
   4. Point to Point details that indicate the interconnections between the items of equipment.
   5. Technical data showing exact types and quantity of all fire alarm devices. Highlight or otherwise identify specific components on catalog cut sheets. All
equipment drawing alarm or supervisory current shall have documentation of the current draw highlighted in the submittal information.

6. California State Fire Marshal listing sheet with current expiration date for each component.

7. Battery capacity calculations: Complete battery calculation sheet showing all the electrical requirements of the entire fire alarm system, including the power consumption of the individual devices, both in alarm and supervisory modes shall be submitted, on 8-½” x 11” paper, including battery calculation for door hold open devices systems.

8. Voltage drop calculations which shall be point to point on indicating device circuits.

9. The title page of the drawings shall include an accurate legend of symbols for all fire alarm devices being installed. In addition, the legend must include the quantity, model number and State Fire Marshal listing number for each device.

10. Annunciator text message and device address for each device shown on submittals.

11. Indicate that the control panel has 25% capacity left for expansion of modules, initiating circuits, initiating point capacity on signaling circuits, alarm circuits and on door release circuits.

12. Elevation drawing that shows all fire alarm equipment enclosures and raceways on the wall where they will be installed. Panels must not be higher that 6 feet, and system status displays should be at eye level. No equipment or raceways may be located under a cabinet containing batteries.

13. A wire list that shows the wire type, gauge and conductor count for all wires and cables.


15. Details on support and anchorage of any fire alarm equipment weighing over 20 pounds.

16. Details and listing number of through penetration fire stop system.

17. Provide sequence of operations to show how system will react to the activation of each type of device.

18. The title page of the drawings must include the following statements:

a. The fire alarm system shall conform to Article 760 of the California Electrical Code. Installation of the fire alarm system shall not be started until detailed drawings and specifications, including current State Fire Marshal listing sheets for each component of the fire alarm system, have been approved by the State Fire Marshal, the University Fire Department and the University Plant Operations and Maintenance department.

b. A set of approved fire alarm shop drawings stamped by Contractor’s engineer of record shall be on the job site and used for installation. Any deviation from approved shop drawings, including substitution of devices, shall be approved by the State Fire Marshal and the University Representative.

c. Any discrepancies between the drawings and the code or recognized standards shall be brought to the attention of the University Representative.

d. Upon completion of the installation of the fire alarm system, the contractor shall coordinate with other trades to test interconnections of the fire alarm system with other building systems and equipment. Once all functions indicated in the fire alarm system sequence operations have been verified through testing, an acceptance test must be performed in the presence of State Fire Marshal and the University Fire Department. The acceptance test must successfully demonstrate all functions required in the contract.

e. Stamp and signature of the design professional of record.
19. Submit simultaneously with shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets.

20. Provide clear and concise operating instructions that gives, in detail, the information required to properly operate the equipment and system.

21. Submittals will be automatically rejected if complete listing information does not accompany submittal.

22. Provide documentation stating that spare parts will be continued to be manufactured or be stocked and available for a minimum of 5 years after the complete system acceptance by the University Representative.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Refer to Division 01 – Product Requirements

1.6 SITE EXAMINATION AND CONDITIONS

A. Refer to Division 01 – Summary of the Work, & Cutting and Patching

B. Information shown on the drawings is based upon available records and data and shall be regarded as approximate only. Make minor deviations found necessary to conform with actual locations and conditions with no increase in contract sum.

C.

1.7 FIRE ALARM SYSTEM: SCOPE

A. General:
1. This project includes the complete and fully functional fire alarm system as specified by the University Representative for the hospital or building.

2. The system shall annunciate individually a trouble or alarm condition for each alarm initiation device in the building. Do not connect more than 75% of loop capacity on any loop. No more than 119 devices on any loop. Do not use more than 7 loops in any multiplex panel. The remaining device and loop capacities shall be maintained as spare for future.

3. Provide all necessary devices for connection to Notifier network and Surgard alarm receiver(s) for transmission of trouble and alarm signals by individual zones as designated by University Representative to University Fire Dispatch and University monitoring points.

4. Existing FACP’s have been upgraded to the new NFS2-3030 systems in prior Panel Upgrade project. The existing Riser project provided raceways from main FACP located in G613 to each floor. New construction under separate project will use these existing panels and incorporate voice evacuation system into the remodeled areas along with adding SLC cards and cable to floors along with amplifiers and NAC panels per floor at designated locations. New field devices and wiring to be added throughout new remodeled spaces.

B. The scope of the work under this project is to provide and install:
1. Provide a complete automatic addressable fire alarm system as shown on the plans and the required fire alarm components. Provide interface connections to the main Fire Alarm Control Panel for monitor of the fire alarm system.

2. The general scope of work is as follows:
   a. All equipment necessary for the new fire alarm devices connection to the University Main Notifier Fire Alarm System.
b. Provide manual pull station and connect to the Notifier NFS2-3030 fire alarm panel, where indicated or required by code.

c. Connect new fire alarm devices to existing Notifier NFS2-3030 fire alarm panel via existing NAC and SLC loops as required.

d. Provide combination synchronized speaker and visual alarm devices and connect to the Notifier fire alarm control panel, where indicated or required by code.

e. Provide smoke detectors and heat detectors and connect to the Notifier control panel, where indicated or required by code.

f. Provide duct smoke detectors and connect to the Notifier control panel, where indicated or required by code.

g. Provide a fire alarm signal UDACT transmitter to transmit signal to the University Fire Dispatch, where indicated or required by code.

h. Provide flow and tamper switches and connect to the Notifier fire alarm control panel, where indicated or required by code.

i. Provide fire alarm module devices and connection to new smoke control system for stair 5 smoke pressurization fan.

j. Provide Notifier manufacturer type fireman’s phones where noted in construction documents with connection for fire alarm amplifier installed under separate project “East Wing Fire Alarm Upgrade”. Refer to reference drawings.

k. Coordinate and tie new fire alarm devices required under this project with fire alarm devices installed under separate project “East Wing Fire Alarm Upgrade” for a complete and operable system.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL

A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

B. All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer’s installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation. Refer to the riser/connection diagram for all specific system installation/termination/wiring data.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2 CONDUIT AND WIRE

A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
2. Where possible, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40% of interior cross sectional area where three or more cables are contained within a single conduit.

3. Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760.

4. Wiring for 24 volt control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.

6. Conduit shall be ¾” minimum.

B. Wire
   1. All fire alarm system wiring must be new.
   2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for initiating device circuits and signaling line circuits, and 14 AWG (1.63 mm) for notification appliance circuits.
   3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
   4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
   5. The system shall permit the use of IDC and NAC wiring in the same conduit with the multiplex communication loop.
   6. All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of any internal modules, or any open circuits in the field wiring; a trouble signal will be activated until the system and its associated field wiring are restored to normal condition.
   7. All analog voice speaker and analog telephone circuits shall use twisted/shielded pair to eliminate cross talk.
   8. Stranded wire only shall be used for all visual notification circuits.

C. Circuits & Pathways
   1. All SLC circuits shall be Class “A” pathways.
   2. All Initiation Circuits shall be Class “B” pathway from module to device.
   3. All Notification Circuits shall be Class “B” pathways.
   4. All Low Level Audio Circuits shall be Class “A” pathways.
   5. Pathway Survivability shall be Level 1 type.
   6. Shared Pathway shall be Level 1 type.

D. Terminal Boxes, Junction Boxes and Cabinets:
   1. All boxes and cabinets shall be UL listed for their intended purpose.

E. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

F. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel
as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

2.3 MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE (EXISTING)

A. The main FACP Central Console shall be a NOTIFIER Model NFS2-3030 and shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, control circuits, and notification appliance circuits, local and remote operator terminals, printers, annunciators, and other system controlled devices.

B. In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FACP shall perform the following functions:
   1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
   2. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.
   3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.
   4. Visually and audibly annunciate any trouble, supervisory, security or alarm condition on operator's terminals, panel display, and annunciators.
   5. When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
      a. The system alarm LED shall flash.
      b. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
      c. The 640-character backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
      d. Printing and history storage equipment shall log and print the event information along with a time and date stamp.
      e. All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
      f. When a trouble condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
         g. The system trouble LED shall flash.
         h. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
         i. The 640-character backlit LCD display shall indicate all information associated with the trouble condition, including the type of trouble point and its location within the protected premises.
         j. Printing and history storage equipment shall log and print the event information along with a time and date stamp.
         k. All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated system outputs (trouble notification appliances and/or relays) shall be activated.
6. When a supervisory condition is detected and reported by one of the system
initiating devices or appliances, the following functions shall immediately occur:
   a. The system trouble LED shall flash.
   b. A local piezo-electric audible device in the control panel shall sound a
distinctive signal.
   c. The 640-character backlight LCD display shall indicate all information
associated with the supervisory condition, including the type of trouble
point and its location within the protected premises.
   d. Printing and history storage equipment shall log and print the event
information along with a time and date stamp.
   e. All system outputs assigned via preprogrammed equations for a
particular point in trouble shall be executed, and the associated system
outputs (notification appliances and/or relays) shall be activated.

7. When a security alarm condition is detected and reported by one of the system
initiating devices or appliances, the following functions shall immediately occur:
   a. The system security LED shall flash.
   b. A local piezo-electric audible device in the control panel shall sound a
distinctive signal.
   c. The 640-character backlight LCD display shall indicate all information
associated with the fire alarm condition, including the type of alarm point
and its location within the protected premises.
   d. Printing and history storage equipment shall log and print the event
information along with a time and date stamp.
   e. All system outputs assigned via preprogrammed equations for a
particular point in alarm shall be executed, and the associated system
outputs (alarm notification appliances and/or relays) shall be activated.

8. When a pre-alarm condition is detected and reported by one of the system
initiating devices or appliances, the following functions shall immediately occur:
   a. The system pre-alarm LED shall flash.
   b. A local piezo-electric audible device in the control panel shall sound a
distinctive signal.
   c. The 640-character backlight LCD display shall indicate all information
associated with the fire alarm condition, including the type of alarm point
and its location within the protected premises.
   d. Printing and history storage equipment shall log and print the event
information along with a time and date stamp.
   e. All system outputs assigned via preprogrammed equations for a
particular point in alarm shall be executed, and the associated system
outputs (alarm notification appliances and/or relays) shall be activated.

C. Operator Control
   1. Acknowledge Switch:
      a. Activation of the control panel acknowledge switch in response to new
alarms and/or troubles shall silence the local panel piezo electric signal
and change the alarm and trouble LEDs from flashing mode to steady-
ON mode. If multiple alarm or trouble conditions exist, depression of this
switch shall advance the LCD display to the next alarm or trouble
condition. In addition, the FACP shall support Block Acknowledge to
allow multiple trouble conditions to be acknowledged with a single
depression of this switch.
      b. Depression of the Acknowledge switch shall also silence all remote
annunciator piezo sounders.

2. Signal Silence Switch:
   a. Depression of the Signal Silence switch shall cause all programmed
alarm notification appliances and relays to return to the normal condition.
The selection of notification circuits and relays that are silence able by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

3. Drill Switch:
   a. Depression of the Drill switch shall activate all programmed notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

4. System Reset Switch:
   a. Depression of the System Reset switch shall cause all electronically latched initiating devices to return to their normal condition. Initiating devices shall re-report if active. Active notification appliance circuits shall not silence upon Reset. Systems that de-activate and subsequently re-activate notification appliance circuits shall not be considered equal. All programmed Control-By-Event equations shall be re-evaluated after the reset sequence is complete if the initiating condition has cleared. Non-latching trouble conditions shall not clear and re-report upon reset.

5. Lamp Test:
   a. The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.

6. Scroll Display Keys:
   a. There shall be Scroll Display keys for FIRE ALARM, SECURITY, SUPERVISORY, TROUBLE, and OTHER EVENTS. Depression of the Scroll Display key shall display the next event in the selected queue allowing the operator to view events by type.

7. Print Screen:
   a. Depression of the PRINT SCREEN switch shall send the information currently displayed on the 640-character display to the printer.

D. System Capacity and General Operation
1. The control panel shall be capable of expansion via up to 10 SLC modules. Each module shall support a maximum of 318 analog/addressable devices for a maximum system capacity of 3180 points. The system shall be capable of 3072 annunciation points per system regardless of the number of addressable devices.

2. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 640-character liquid crystal display, individual, color coded system status LEDs, and a QWERTY style alphanumeric keypad for the field programming and control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either the owner or installing company.

3. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.

4. The FACP shall be able to provide the following software and hardware features:
   a. Pre-signal and Positive Alarm Sequence: The system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-second time period for acknowledging an alarm signal from a fire detection/initiating device. If the alarm is not acknowledged within 15 seconds, all local and remote outputs shall automatically activate immediately.
b. Smoke Detector Pre-alarm Indication at Control Panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.

c. Alert: It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.

d. Action: If programmed for Action and the detector reaches a level exceeding the pre-programmed level, the control panel shall indicate an action condition. Sounder bases installed with either heat or smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on Alarm level.

e. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.

f. Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.

g. NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meet the requirements of NFPA 72.

h. Programmable Trouble Reminder: The system shall provide means to automatically initiate a reminder that troubles exist in the system. The reminder will appear on the system display and (if enabled) will sound a piezo alarm.

i. On-line or Off-line programming: The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database and panel executive system program to a Personal Computer/laptop.

j. History Events: The panel shall maintain a history file of the last 4000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall also maintain a 1000 event Alarm History buffer, which consists of the 1000 most recent alarm events from the 4000 event history file.

k. Smoke Control Modes: The system shall provide means to perform FSCS mode Smoke Control to meet NFPA-92A and 90B and HVAC mode to meet NFPA 90A.

l. The system shall provide means for all SLC devices on any SLC loop to be auto programmed into the system by specific address. The system shall recognize specific device type ID’s and associate that ID with the corresponding address of the device.

m. Drill: The system shall support means to activate all silenceable fire output circuits in the event of a practice evacuation or “drill”. If enabled for local control, the front panel switch shall be held for a minimum of 2 seconds prior to activating the drill function.

n. Passwords and Users: The system shall support two password levels, master and user. Up to 9 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.

o. Two Wire Detection: The system shall support standard two wire detection devices specifically all models of System Sensor devices,

p. Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions

q. Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.

r. Environmental Drift Control: The system shall provide means for setting Environmental Drift Compensation by device. When a detector accumulates dust in the chamber and reaches an unacceptable level but yet still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.

s. Custom Action Messages: The system shall provide means to enter up to 100 custom action messages of up to 160 characters each. It shall be possible to assign any of the 100 messages to any point.

t. Print Functions: The system shall provide means to obtain a variety of reports listing all event, alarm, trouble, supervisory, or security history. Additional reports shall be available for point activation for the last Walk Test performed, detector maintenance report containing the detector maintenance status of each installed addressable detector, all network parameters, all panel settings including broadcast time, event ordering, and block acknowledge, panel timer values for Auto Silence, Silence Inhibit, AC Fail Delay time and if enabled, Proprietary Reminder, and Remote Reminder timers, supervision settings for power supply and printers, all programmed logic equations, all custom action messages, all non-fire and output activations (if pre-programmed for logging) all active points filtered by alarms only, troubles only, supervisory alarms, prealarms, disabled points and activated points, all installed points filtered by SLC points, logic zones, annunciators, releasing zones, special zones, and trouble zones.

u. Local Mode: If communication is lost to the central processor the system shall provide added survivability through the intelligent loop control modules. Inputs from devices connected to the SLC and loop control modules shall activate outputs on the same loop when the inputs and outputs have been set with point programming to participate in local mode or when the type codes are of the same type: that is, an input with a fire alarm type code shall activate an output with a fire alarm type code.

v. Resound based on type for security or supervisory: The system shall indicate a Security alarm when a monitor module point programmed with a security Type Code activates. If silenced alarms exist, a Security alarm will Resound the panel sounder. The system shall indicate a Supervisory alarm when a monitor module point programmed with a supervisory Type Code activates. If there are silenced alarms, a Supervisory alarm will Resound the panel sounder.

w. Read status preview - enabled and disabled points: Prior to re-enabling points, the system shall inform the user that a disabled device is in the alarm state. This shall provide notice that the device must be reset before the device is enabled thereby avoiding activation of the notification circuits.

x. Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.
y. Multi-Detector and Cooperating Detectors: The system shall provide means to link one detector to up to two detectors at other addresses on the same loop in cooperative multi-detector sensing. There shall be no requirement for sequential addresses on the detectors and the alarm event shall be a result or product of all cooperating detectors' chamber readings.

z. Tracking/Latching Duct (ion and photo): The system shall support both tracking and latching duct detectors either ion or photo types.

aa. ACTIVE EVENT: The system shall provide a Type ID called FIRE CONTROL for purposes of air-handling shutdown, which shall be intended to override normal operating automatic functions. Activation of a FIRE CONTROL point shall cause the control panel to (1) initiate the monitor module Control-by-Event, (2) send a message to the panel display, history buffer, installed printer and annunciators, (3) shall not light an indicator at the control panel, (4) Shall display ACTIVE on the LCD as well a display a FIRE CONTROL Type Code and other information specific to the device.

bb. NON-FIRE Alarm Module Reporting: A point with a type ID of NON-FIRE shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel operation nor shall it display a message at the panel LCD. Activation of a NON-FIRE point shall activate control by event logic but shall not cause any indication on the control panel.

c. Security Monitor Points: The system shall provide means to monitor any point as a type security.

d. One-Man Walk Test: The system shall provide both a basic and advanced walk test for testing the entire fire alarm system. The basic walk test shall allow a single operator to run audible tests on the panel. All logic equation automation shall be suspended during the test and while annunciators can be enabled for the test, all shall default to the disabled state. During an advanced walk test, field-supplied output point programming will react to input stimuli such as CBE and logic equations. When points are activated in advanced test mode, each initiating event shall latch the input. The advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device and wiring operation/verification.

e. Control By Event Functions: CBE software functions shall provide means to program a variety of output responses based on various initiating events. The control panel shall operate CBE through lists of zones. A zone shall become listed when it is added to a point’s zone map through point programming. Each input point such as detector, monitor module or panel circuit module shall support listing of up to 10 zones into its programmed zone map.

ff. Permitted zone types shall be general zone, releasing zone and special zone. Each output point (control module, panel circuit module) can support a list of up to 10 zones including general zone, logic zone, releasing zone and trouble zone. It shall be possible for output points to be assigned to list general alarm. Non-Alarm or Supervisory points shall not activate the general alarm zone.

gg. 1000 General Zones: The system shall support up to 1000 general purpose software zones for linking inputs to outputs. When an input device activates, any general zone programmed into that device’s zone map will be active and any output device that has an active general zone in its map will be active. It shall also be possible to use general zone as arguments in logic equations.
hh. 1000 Logic Equations: The system shall support up to 1000 logic
equations for AND, OR, NOT, ONLY1, ANYX, XZONE or RANGE
operators that allow conditional I/O linking. When any logic equation
becomes true, all output points mapped to the logic zone shall activate.

ii. 10 trouble equations per device: The system shall provide support for up
to 10 trouble equations for each device, which shall permit programming
parameters to be altered, based on specific fault conditions. If the
trouble equation becomes true, all output points mapped to the trouble
zone shall activate.

jj. Control-By-Time: A time based logic function shall be available to delay
an action for a specific period of time based upon a logic input with
tracking feature. A latched version shall also be available. Another
version of this shall permit activation on specific days of the week or year
with ability to set and restore based on a 24 hour time schedule on any
day of the week or year.

kk. Multiple agent releasing zones: The system shall support up to 10
releasing zones to protect against 10 independent hazards. Releasing
zones shall provide up to three cross-zone and four abort options to
satisfy any local jurisdiction requirements.

ll. Alarm Verification, by device, with timer and tally: The system shall
provide a user-defined global software timer function that can be set for a
specific detector or indicating panel module input. The timer function
shall delay an alarm signal for a user-specified time period and the
control panel shall ignore the alarm verification timer if another alarm is
detected during the verification period. It shall also be possible to set a
maximum verification count between 0 and 20 with the “0” setting
producing no alarm verification. When the counter exceeds the
threshold value entered, a trouble shall be generated to the panel.

E. Central Processing Unit

1. The Central Processing Unit shall communicate with, monitor, and control all
other modules within the control panel. Removal, disconnection or failure of any
control panel module shall be detected and reported to the system display by the
Central Processing Unit.

2. The Central Processing Unit shall contain and execute all control-by-event
(including Boolean functions including but not limited to AND, OR, NOT, ANYx,
and CROSSZONE) programs for specific action to be taken if an alarm condition
is detected by the system. Such control-by-event programs shall be held in non-
volatile programmable memory, and shall not be lost with system primary and
secondary power failure.

3. The Central Processing Unit shall also provide a real-time clock for time
annotation, to the second, of all system events. The time-of-day and date shall
not be lost if system primary and secondary power supplies fail.

4. The CPU shall be capable of being programmed on site without requiring the use
of any external programming equipment. Systems that require the use of external
programmers or change of EPROMs are not acceptable.

5. Consistent with UL864 standards, the CPU and associated equipment are to be
protected so that voltage surges or line transients will not affect them.

6. Each peripheral device connected to the CPU shall be continuously scanned for
proper operation. Data transmissions between the CPU and peripheral devices
shall be reliable and error free. The transmission scheme used shall employ dual
transmission or other equivalent error checking techniques.

7. The CPU shall provide an EIA-232 interface between the fire alarm control panel
and the UL Listed Electronic Data Processing (EDP) peripherals.
8. The CPU shall provide two EIA-485 ports for the serial connection to
annunciation and control subsystem components.
9. The EIA-232 serial output circuit shall be optically isolated to assure protection
from earth ground.
10. The CPU shall provide one high-speed serial connection for support of network
communication modules.
11. The CPU shall provide double pole relays for FIRE ALARM, SYSTEM
TROUBLE, SUPERVISORY, and SECURITY. The SUPERVISORY and
SECURITY relays shall provide selection for additional FIRE ALARM contacts.

F. Display
1. The system display shall provide all the controls and indicators used by the
system operator and may also be used to program all system operational
parameters.
2. The display assembly shall contain, and display as required, custom
alphanumeric labels for all intelligent detectors, addressable modules, and
software zones.
3. The system display shall provide a 640-character backlit alphanumeric Liquid
Crystal Display (LCD). It shall also provide ten Light-Emitting-Diodes (LEDs), that
indicate the status of the following system parameters: AC POWER, FIRE
ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE,
OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, and CPU FAILURE.
4. The system display shall provide a QWERTY style keypad with control capability
to command all system functions, entry of any alphabetic or numeric information,
and field programming. Two different password levels with up to ten (one Master
and nine User) passwords shall be accessible through the display interface
assembly to prevent unauthorized system control or programming.
5. The system display shall include the following operator control switches:
ACKNOWLEDGE, SIGNAL SILENCE, RESET, DRILL, and LAMP TEST.
Additionally, the display interface shall allow scrolling of events by event type
including, FIRE ALARM, SECURITY, SUPERVISORY, TROUBLE, and OTHER
EVENTS. A PRINT SCREEN button shall be provided for printing the event
currently displayed on the 640-character LCD.

G. Loop (Signaling Line Circuit) Control Module:
1. The Loop Control Module shall monitor and control a minimum of 318 intelligent
addressable devices. This includes 159 intelligent detectors (Ionization,
Photoelectric, or Thermal) and 159 monitor or control modules.
2. The Loop Control Module shall contain its own microprocessor and shall be
capable of operating in a local/degrade mode (any addressable device input shall
be capable of activating any or all addressable device outputs) in the unlikely
event of a failure in the main CPU.
3. The Loop Control Module shall provide power and communicate with all
intelligent addressable detectors and modules on a single pair of wires. This SLC
Loop shall be capable of operating as a NFPA Style 6 (Class A) circuit.
4. The SLC interface board shall be able to drive an NFPA Style 6 twisted
unshielded circuit up to 12,500 feet in length. The SLC Interface shall also be
capable of driving an NFPA Style 6, no twist, no shield circuit for limited
distances determined by the manufacturer. In addition, SLC wiring shall meet
the listing requirements for it to exit the building or structure. No "T"-tapping will
be allowed in either case.
5. The SLC interface board shall receive analog or digital information from all
intelligent detectors and shall process this information to determine whether
normal, alarm, or trouble conditions exist for that particular device. Each SLC
Loop shall be isolated and equipped to annunciate an Earth Fault condition. The
SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

H. Enclosures:
1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.
3. The door shall provide a key lock and include a transparent opening for viewing all indicators. For convenience, the door shall have the ability to be hinged on either the right or left-hand side.
4. The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

I. Power Supply:
1. The Addressable Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.
2. The Addressable Main Power Supply shall provide the required power to the CPU using a switching 24 VDC regulator and shall incorporate a battery charger for 24 hours of standby power using dual-rate charging techniques for fast battery recharge.
3. The Addressable Main Power Supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. The supply shall be capable of charging batteries ranging in capacity from 25-200 amp-hours within a 48-hour period.
4. The Addressable Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
5. The Addressable Main Power Supply shall be power-limited per UL864 requirements.

J. System Circuit Supervision
1. The FACP shall supervise all circuits to intelligent devices, transponders, annunciators and peripheral equipment and announce loss of communication with these devices. The CPU shall continuously scan above devices for proper system operation and upon loss of response from a device shall sound an audible trouble, indicate which device or devices are not responding and print the information in the history buffer and on the printer.
2. Transponders that lose communication with the CPU shall sound an audible trouble and light an LED indicating loss of communications.
3. Sprinkler system valves, standpipe control valves, PIV, and main gate valves shall be supervised for off-normal position.
4. All speaker and emergency phone circuits shall be supervised for opens and shorts. Each transponder speaker and emergency phone circuit shall have an individual ON/OFF indication (green LED).

K. Field Wiring Terminal Blocks
1. All wiring terminal blocks shall be the plug-in/removable type and shall be capable of terminating up to 12 AWG wire. Terminal blocks that are permanently fixed to the PC board are not acceptable.

L. Controls with associated LED Indicators:
1. Speaker Switches/Indicators
   a. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.
   b. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.

2. Emergency Two-Way Telephone Control Switches/Indicators
   a. The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.
   b. The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

M. Remote Transmissions:
   1. Provide local energy or polarity reversal or trip circuits as required.
   2. The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the fire department.
   3. Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator’s terminals, system printers and annunciators.
   4. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

N. System Expansion:
   1. Design the main FACP and required components so that the system can be expanded in the future (to include the addition of twenty-five percent more circuits or zones) without disruption or replacement of the existing control panel. This shall include hardware capacity, software capacity and cabinet space.

O. Field Programming
   1. The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.
   2. It shall be possible to program through the standard FACP keyboard all system functions.
   3. All field defined programs shall be stored in non-volatile memory.
   4. Two levels of password protection shall be provided in addition to a key-lock cabinet. One level shall be used for status level changes such as point/zone disable or manual on/off commands (Building Manager). A second (higher-level) shall be used for actual change of the life safety program (installer). These passwords shall be five (5) digits at a minimum. Upon entry of an invalid password for the third time within a one minute time period an encrypted number shall be displayed. This number can be used as a reference for determining a forgotten password.
   5. The system programming shall be "backed" up via an upload/download program, and stored on compatible removable media. A system back-up disk shall be completed and given in duplicate to the building owner and/or operator upon completion of the final inspection. The program that performs this function shall be "non-proprietary", in that, it shall be possible to forward it to the building owner/operator upon his or her request.
   6. The installer’s field programming and hardware shall be functionally tested on a computer against known parameters/norms which are established by the FACP manufacturer. A software program shall test Input-to-Output correlations, device
Type ID associations, point associations, time equations, etc. This test shall be performed on an IBM-compatible PC with a verification software package. A report shall be generated of the test results and two copies turned in to the engineer(s) on record.

P. Specific System Operations:
1. Smoke Detector Sensitivity Adjust: Means shall be provided for adjusting the sensitivity of any or all analog intelligent smoke detectors in the system from the system keypad or from the keyboard of the video terminal. Sensitivity range shall be within the allowed UL window.
2. Alarm Verification: Each of the Intelligent Addressable Smoke Detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification function shall be programmable from 5 to 50 seconds and each detector shall be able to be selected for verification during the field programming of the system or anytime after system turn-on. Alarm verification shall not require any additional hardware to be added to the control panel. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

Q. System Point Operations:
1. Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or video terminal.
2. System output points shall be capable of being turned on or off from the system keypad or the video terminal.
3. Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:
   a. Device Status.
   b. Device Type.
   c. Custom Device Label.
   d. Software Zone Label.
   e. Device Zone Assignments.
   f. Analog Detector Sensitivity.
   g. All Program Parameters.
4. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system statuses:
5. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 4000 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed; one event at a time, and the actual number of activations may also be displayed and or printed. History events shall include all alarms, troubles, operator actions, and programming entries.
6. The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.
7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.
8. If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
9. The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personal when a detector is at 80% of its alarm threshold in a 60 second period.

2.4 SYSTEM COMPONENTS

A. Speakers:
   1. All speakers shall operate on 25 VRMS or with field selectable output taps from 0.5 to 2.0 Watts.
   2. Speakers in corridors and public spaces shall produce a nominal sound output of 84 dBA at 10 feet (3m).
   3. Frequency response shall be a minimum of 400 HZ to 4000 HZ.
   4. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.

B. Strobe lights shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria:
   1. The maximum pulse duration shall be 2/10 of one second.
   2. Strobe intensity shall meet the requirements of UL 1971.
   3. The flash rate shall meet the requirements of UL 1971.

C. Waterflow Indicator:
   1. Waterflow Switches shall be an integral, mechanical, non-coded, non-accumulative retard type.
   2. Waterflow Switches shall have an alarm transmission delay time which is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds.
   3. All waterflow switches shall come from a single manufacturer and series.
   4. Waterflow switches shall be provided and connected under this section but installed by the mechanical contractor.
   5. Where possible, locate waterflow switches a minimum of one (1) foot from a fitting which changes the direction of the flow and a minimum of three (3) feet from a valve.

D. Sprinkler and Standpipe Valve Supervisory Switches:
   1. Each sprinkler system water supply control valve riser, zone control valve, and standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
   2. PIV (post indicator valve) or main gate valves shall be equipped with a supervisory switch.
   3. The switch shall be mounted so as not to interfere with the normal operation of the valve and adjusted to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
   4. The supervisory switch shall be contained in a weatherproof aluminum housing, which shall provide a ¾” (19 mm) conduit entrance and incorporate the necessary facilities for attachment to the valves.
   5. The switch housing shall be finished in red baked enamel.
   6. The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting.
   7. Valve supervisory switches shall be provided and connected under this section and installed by mechanical contractor.
a. This unit shall provide for each zone: alarm indications, using a red alarm a yellow trouble long-life LEDs and control switches for the control of fire alarm control panel functions. The annunciator will also have an ON-LINE LED, local piezo electric signal, local acknowledge/lamp test switch, and custom slide-in zone/function identification labels.

b. Switches shall be available for remote annunciation and control of output points in the system, system acknowledge, telephone zone select, speaker select, global signal silence, and global system reset within the confines of all applicable standards.

E. Fixed Emergency Telephone Handset

1. The telephone cabinet shall be painted red and clearly labeled as "Emergency Telephone." The cabinets shall be located where shown on drawings.

2. The handset cradle shall have a switch connection so that lifting the handset off of the cradle shall send a signal to the fire command center, which shall audibly and visually indicate its on-line (off-hook) condition.

3. On activating the remote phone, the phone earpiece shall sound a telephone ring signal until the master handset is lifted.

4. The two-way emergency telephone system shall support a minimum of seven (7) handsets on line without degradation of the signal.

2.5 SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices - General

1. Addressable devices shall provide an address-setting means using rotary decimal switches.

2. Addressable devices shall use simple to install and maintain decade (numbered 0 to 9) type address switches. Devices which use a binary address or special tools for setting the device address, such as a dip switch are not an allowable substitute.

3. Detectors shall be Analog and Addressable, and shall connect to the fire alarm control panel's Signaling Line Circuits.

4. Addressable smoke and thermal detectors shall provide dual (2) status LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the flashing mode operation of the detector LEDs can be programmed off via the fire control panel program.

5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity can be automatically adjusted by the panel on a time-of-day basis.

6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.

7. The detectors shall be ceiling-mount and shall include a separate twist-lock base which includes a tamper proof feature.

8. The following bases and auxiliary functions shall be available:

   a. Sounder base rated at 85 DBA minimum.
   b. Form-C Relay base rated 30VDC, 2.0A
   c. Isolator base
9. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.

10. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (example: ION, PHOTO, THERMAL).

B. Addressable Manual Fire Alarm Box (manual station)
   1. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
   2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
   3. Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75" (44 mm) or larger.

C. Intelligent Photoelectric Smoke Detector
   1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

D. Intelligent Ionization Smoke Detector
   1. The detectors shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.

E. Intelligent Thermal Detectors
   1. Thermal detectors shall be intelligent addressable devices rated at 135°F (58°C) and have a rate-of-rise element rated at 15°F (9.4°C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

F. Intelligent Duct Smoke Detector
   1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.
   2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.
   3. Remote indicators for concealed devices shall be located on wall directly under where access to the concealed device will be made. If the installer is unsure where to install a remote indicator, contact UCD fire department for direction.

G. Addressable Dry Contact Monitor Module
   1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.
   2. The IDC zone shall be suitable for Style A operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
3. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4” (70 mm) x 1-1/4” (31.7 mm) x ½” (12.7 mm). This version need not include Style D or an LED.

H. Two Wire Detector Monitor Module
1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
2. The IDC zone may be wired for Class B (Style A) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

I. Addressable Control Module
1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances.
2. The control module NAC may be wired for Style Y (Class B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation.
3. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply.
4. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

J. Addressable Relay Module
1. Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

K. Isolator Module
1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. (Module base to be added) Isolator devices shall be provided for each 25 detectors. Isolator detector bases may be used in lieu of isolator modules.
2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
3. The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
4. The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

L. Smoke Control Annunciator
1. On/Auto/Off switches and status indicators (LEDs) shall be provided for monitoring and manual control of each fan, damper, HVAC control unit, stairwell pressurization fan, and smoke exhaust fan. To ensure compliance the units supplied shall meet the following UL categories: UUKL, PAZX, UDTZ, QVAX as well as the requirements of NFPA 90A, HVAC, and NFPA 92A & 92B, Smoke
The control system shall be field programmable for either 90A operation or 92A/B operation to allow for future use and system expansion.

2. The OFF LED shall be Yellow, the ON LED shall be green, the Trouble/Fault LED shall be Amber/Orange for each switch. The Trouble/Fault indicator shall indicate a trouble in the control and/or monitor points associated with that switch. In addition, each group of eight switches shall have two LEDs and one momentary switch which allow the following functions: An Amber LED to indicate an OFF-NORMAL switch position, in the ON or OFF position; A Green LED to indicate ALL AUTO switch position; A Local Acknowledge/Lamp Test momentary switch.

3. Each switch shall have the capability to monitor and control two addressable inputs and two addressable outputs. In all modes, the ON and OFF indicators shall continuously follow the device status not the switch position. Positive feedback shall be employed to verify correct operation of the device being controlled. Systems that indicate on/off/auto by physical switch position only are not acceptable.

4. All HVAC switches (i.e., limit switches, vane switches, etc.) shall be provided and installed by the HVAC contractor.

5. It shall be possible to meet the requirements mentioned above utilizing wall mounted custom graphic.

2.6 BATTERIES AND EXTERNAL CHARGER

A. Battery:
   1. Shall be 12 volt, Gell-Cell type.
   2. Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.
   3. The batteries are to be completely maintenance free. No liquids are required.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all components as shown on drawings and in accordance with all codes, manufacturers’ diagrams, University’s policy and procedures. If the drawings contradict codes or manufacturers’ data sheets, the Contractor shall immediately contact the University’s Representative to clarify and correct the problem.

B. Manual pull stations shall be installed at 48” center above finished floor.

C. Connect conduit to water flow and valve supervisory switches with flexible liquid tight conduit. Adjusting timing of water flow and initiating devices as requested by University’s Representative. Place modules and addressable devices for these devices in a rain tight box. Contractor shall provide an authorized Manufacturer’s Representative to instruct and train University’s personnel in operation of system. Arrange for two eight (8) hour sessions of training on the operation of the fire alarm system, this will be scheduled on two separate days. Training shall be conducted after final inspection and test is completed but prior to beneficial occupancy. Provide five (5) working days notice to arrange training session with University’s Representative. Training shall include UCDMC PO&M personnel and UCDMC Fire Department. Training shall cover the operation, maintenance and repair of the complete system. "Hands-on" demonstrations of the
operation and replacement of all system components and the entire system including program changes and function shall be provided.

D. Install all components as indicated and in accord with manufacturer's wiring diagrams, instructions and recommendations. Assemble together all equipment which requires assembling including contractor's supplied bussing, internal wire connections where required. Connect all incoming conduit, cable and wires properly, and adjust and make ready for service electrical equipment and material required by this contract.

E. Install all wiring in accord with local and national codes and NFPA 72.

F. Equipment: Accurately and neatly set, level, place supports and anchors properly. Anchor with bolts to 0.56G for essential equipment and 0.22G for nonessential equipment to prevent movements in an earthquake. No allowance will be made for negligence due to foreseen or unforeseen means of placing or installing, equipment into position.

G. All work shall be done in an orderly, workmanlike manner, and present a neat appearing installation when completed.

H. All field and FACP wiring shall be terminated in terminal cabinets or on field devices. All components shall be made on terminals. Circuit completions shall be accomplished with cross-connect jumpers. Make all fire alarm wiring continuous from terminals to terminal or from terminal to device pigtail lead. All initiation devices are to be wired without parallel branches (T tapping) and are to start and return at the main terminal cabinet. Spare conductors are to be provided on a 10% (minimum two conductor) schedule per riser; annunciator panels shall be wired for full capacity, plus a minimum of six (6) spare conductors.

1. Circuit splices not permitted,
2. Wiring joints, only when required at devices pigtail leads shall utilize terminal strips.
3. The use of wire nuts, crimp connector and similar shall not be allowed. Wire shall be terminated under screw heads with a fork type terminal installed in the wire. Wrapping of wire under screws heads will not be permitted.

I. Detectors shall be installed and located in accordance with the manufacturer's written instructions and the UL listing requirements. Locate detectors with pilot light visible from floor. Do not conceal behind HVAC ductwork. Locate smoke detectors not less than five feet from any supply or return air diffuser. No smoke detectors shall be installed until the area has been thoroughly cleaned, the ventilation system has been on for a minimum of one hour and construction is finished.

J. Conduit shall be packed with removable sealant where connected to ceiling or duct detectors.

K. Addressable Modules shall be installed in a box on all devices that require the use of such, including manual pull stations, smoke detectors, waterflow indicators O, S & Y valve, post indicator valves and all other initiating devices.

L. Install all wiring in rigid, intermediate or electrical metallic conduit, minimum conduit size is ¾". All conduit except that which is exposed in public areas shall be painted red in color at least every 6 feet for the entire circumference of the conduit. This red marking shall be at least 6" long. All concealed junction boxes shall also be painted red. Run circuits for AC separate from circuits using DC. They shall not be permitted to share the same conduit. All initiating device and signaling line circuits shall be run above-grade.
Exposed flexible conduit, as used for attachment to water-flow and valve tamper switches or similar applications, shall be liquidtight and shall be the minimum length required for neat and secure installation. Flexible conduit shall not be buried nor located closer than 12" to grade.

M. All equipment and devices installed in exterior and wet locations shall be installed in an approved gasketed NEMA 3R enclosure. All conduit, fittings and hardware shall be corrosion resistant rigid type.

N. Equipment installed in flammable or explosive atmospheres shall be approved and listed for such application. All raceway and fittings shall be installed in accordance with the State Electrical Code for hazardous (classified) locations.

O. Provide a ¾" conduit with a pull string from FACP to the nearest telephone terminal board. No fire alarm circuits shall be run with conductors from any other systems.

P. All wiring and telephone cabling shall be in metal conduit, with any shielded wire connected to an earth ground at the control panel. No signal wiring shall be permitted outside of metal conduit without shielded type wiring and approval by the University's Representative (University's Representative's Consultant, UCDMC PO&M and University Representative).

Q. Where FACP Panels and termination cabinets are mounted flush to finished wall or in areas where the finished ceiling is solid, install two (2) empty ¾" conduits from the FACP to the attic area above in an accessible area. Terminate each of them in a separate 4 11/16" box in a accessible area.

R. Installation of equipment and devices that pertain to other work in contract shall be closely coordinated.

S. Cover all smoke detector devices with plastic bags immediately after installation to maintain cleanliness.

T. The fire alarm designer shall be responsible to determine the quality and location of audible devices that will provide the required 15 decibels above ambient noise levels in every square foot of floor area.

U. Programming:
   1. Provide all initial system programming.
   2. Provide University with a set of drawings indicating zones and zone boundaries for modification and approval prior to programming zones.
   3. Coordinate system programming with University.
   4. Obtain a list of University's room numbers. These room numbers shall be provided by University's Representative prior to beneficial occupancy of the building. Correct all final programming and as-built drawings submitted to University for O&M manuals to reflect correct room numbers.

V. Grounding:
   1. All metallic conduit, cabinets, junction boxes, and exposed non-current-carrying metal parts shall be permanently grounded. A separate No. 10 AWG conductor shall connect a grounding bus bar located in each main terminal cabinet to building ground. The bus bar shall be provided with a minimum of five tubular, pressure type screw terminals sized for No. 18 AWG through No. 10 AWG wire.
The ground wire for the FACP and the main terminal cabinet shall be grounded via the bus bar.

### 3.2 PERFORMANCE

**A. Sleeves, Chases, and Concrete inserts:**
1. Provide as part of work and in a manner to cause no delay all required sleeves, chases, concrete inserts, anchor bolts, and similar items before concrete is placed and be responsible for their correct location and installation.
2. Sleeves and chases are prohibited in structural members except where shown or as otherwise approved in writing.

**B. Cutting and patching:**
1. As specified in Section 01045.
2. Perform all cutting and patching, including structural reinforcing, necessary for this work.
3. Perform no cutting or patching without prior approval. Repair damage done by cutting and patching equal to original condition.

**C.** Provide metal backing plates, anchor plates, and similar items that are required for anchorage for the work of this Section. Securely weld or bolt to metal framing. Wood blocking or backing will not be permitted in combination with metal framing.

**D.** Special forming, recesses, chases, and similar items and wood blocking, backing, and grounds necessary for the proper installation of the fire alarm system will be provided as part of the work.

### 3.3 TESTING ACCEPTANCE

**A.** Contractor shall, under this contract, obtain services of a factory trained representative of system manufacturer to supervise installation and its progress, supervise final connections to equipment and provide testing to assure that system is in proper operating condition, and is in compliance with all applicable regulations. The contractor shall provide 4 sets of preliminary as-built drawings for mark-up during testing, these will be retained by University. The contractor shall perform two separate tests after the system is completed. Each test shall successfully demonstrate all functions required in the contract. One test shall be completed in the presence of the University's Representative (including UCDMC Telecommunications and UCDMC Fire Department) and a separate test shall be conducted for final acceptance by the State Fire Marshal/OSHPD in the presence of the University's Representative (including UCDMC Telecommunications, UCDMC Fire Department.)

**B.** Furnish all labor and test equipment required for this work. Testing work is defined as that work necessary to establish that equipment has been properly assembled, connected, and checked to verify that intent and purpose of drawings, manufacturer's instruction manuals, and directions of University have been accomplished in a satisfactory manner. All failures shall be re-tested at Contractor expense to verify corrections.

**C.** 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.

D. Ground tests shall meet requirements of Part 3, Title 24, CEC.

E. 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 Specifications or submitted data, alter or replace equipment at no increase in Contract Price.

F. 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 condition in which it was found at time of cutting, all at no increase in Contract Price.

3.4 SEQUENCE OF OPERATION

A. A type written "Sequence of Operation" and Fire Alarm Program shall be provided and a copy provided on CD in Microsoft Word and/or Access format.

3.5 SPARE PARTS

A. Provide and turn over to the University the following equipment. Obtain a receipt.

1. Two (2) of each type of automatic initiating device used. (smoke/heat detector) including base, manual pull station, addressable modules.
2. One of each type of alarm annunciating device (strobe, strobe chime or other devices).

3.6 OPERATION AND MAINTENANCE MANUAL RECORD DRAWINGS

A. Provide minimum of 6 copies of the Operations and Maintenance Manual. The manual shall be labeled and neatly installed in a binder with tabs and sections as indicated in a Table of Contents. Large drawings and blueprints shall be neatly folded in. It shall include manufacturers data sheets, maintenance and operation information sheets, copies of all programming sheets with the final University's room numbers included, as
built drawings showing the final University's room numbers, any other information operation or maintenance. Two (2) copies of complete as-built installation wiring documentation, internal fire alarm control panel schematics, and maintenance manuals are to be submitted prior to final acceptance. Deliver one copy directly to Plant Operations and Maintenance, Auxiliary Services Communications Shop as soon as possible.

B. Using the fire alarm 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. The University will receive CAD drawings via appropriate electronic transmission medium, and one set of full-size reproductions plotted drawings. These drawings shall be clearly labeled “Fire Alarm 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 01, General Requirements, Closeout Procedures and Closeout Submittals).

END OF SECTION
PART I - GENERAL

1.01 DESCRIPTION

A. Scope: Work under this Section shall include:

1. Work shall include all clearing of remaining building remnants, slabs, utilities, pavements, trees, shrubbery, fences and associated items, excavation to lines and grades as shown on drawings.

2. Preparation of surfaces to be filled, filling, spreading, compaction, observation, and testing of the fill; preparation of subgrade for building slabs, walks, and pavements.

3. All subsidiary work necessary to complete the grading to conform with the lines, grades, and slopes as shown on the Drawings and specified herein.

4. Backfilling of trenches within building lines.

B. Related Work Specified Elsewhere:

1. Section 22 05 01 – Plumbing Trenching and Backfill: Trenching and backfilling for underground utility systems, including excavation and shoring at Ejector Pump.

1.02 PROTECTION

A. Adequate protection measures shall be provided to protect workmen and passers-by the site. Streets and adjacent property shall be fully protected throughout the operations. Contractor shall comply with City of Sacramento "Work Area and Traffic Control Handbook" (WATCH).

B. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for working conditions at the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours.

C. Any construction review of the Contractor's performance conducted by the University's Representative is not intended to include review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.

D. Adjacent streets and sidewalks shall be kept free of mud, dirt, or similar nuisances resulting from earthwork operations.

E. Surface drainage provisions shall be made during the period of construction in a manner to avoid creating a nuisance to adjacent areas.

F. The site and adjacent influenced areas shall be watered as required to suppress dust nuisance.

G. Trees located within the limits of work, which are not to be removed, shall be protected during grading operations.
1.03 EXISTING SITE CONDITIONS
A. See Division 1, Section 01310 - COORDINATION, 1.07.G Utility Locations.

1.04 SEASONAL LIMITS
A. Fill materials shall not be placed, spread, or rolled during unfavorable weather conditions. When the work is interrupted by heavy rains, fill operations shall not be resumed until field tests indicate that the moisture contents of the subgrade and fill materials are satisfactory.

PART II - PRODUCTS

2.01 MATERIALS:
A. Satisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups OW, UP, EM, SM, SO and SP.

B. Unsatisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GC, SC, ML, AL, CH, OL, OR and PT.

C. Sub-base material: Naturally or artificially traded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crushed sand.

D. Drainage Fill: wastes, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100% passing a #2 sieve and not more than 5% passing a #4 sieve.

E. Backfill and Fill Materials: Satisfactory soil materials free of clay, rock or gravel larger than 2" in any dimension, debris, waste, vegetable and other deleterious matter.

F. Local materials excavated only from existing planter areas may be used as fill for proposed planters.
   1. All fill shall be of approved local materials, supplemented by imported fill, if necessary. Approved local materials are defined as local soils free from quantities of rubble, rubbish, and vegetation, and having been tested and approved by the University’s Representative prior to use.
   2. Local materials excavated from existing paved areas may only be used as fill for proposed paving areas and shall not be used as fill for planters.
   3. Imported fill materials shall be approved by the University’s Representative, meet the above requirements, shall have a plasticity index not exceeding twelve, and shall be of 1" maximum particle size.

G. Imported Topsoil: Sandy Loam, free of debris and persistent weeds acceptable to University's Representative.

H. River sand for bedding and initial backfill shall be free from vegetable material, lumps, balls of clay, or adherent films of clay. The material shall not have more than twenty percent (20%), passing a 200 mesh screen and minor amounts of small gravel up to one half (½”) inch in size will be permitted. Payment for river sand used for bedding and initial backfill shall be included as payment for the utility being installed and shall not be paid as a separate item.
I. Crushed rock, when specified for backfill, shall mean a uniformly graded material that is the product of crushing rock or gravel; free of organic material, oil, alkali, or other deleterious substances and is hard, sound, and durable. Crushed rock shall conform to the requirements for coarse (½" x No. 4) crushed screenings as set forth in Section 37-1.02 of the State Specifications. In addition, crushed rock shall have a minimum cleanliness value of fifty (50) as determined by California Test 227.

PART III - EXECUTION

3.01 LAYOUT AND PREPARATION

A. Layout all work, establish grades, locate and flag existing underground utilities, set markers and stakes, set up and maintain barricades for protection of utilities, all prior to beginning actual earthwork operations.

3.02 CLEARING AND GRUBBING

A. Clearing shall consist of, but shall not be limited to, removal of grass, trees and organic debris, concrete slabs or foundations, drain inlets, headerboards, fences, rubbish, piping, curbs, walks and asphalt paving including surfacing and aggregate base and underground utilities within 2.0' of original or final grade (which ever is lower). Excavations and depressions resulting from the removal of such items, as well as any existing excavations or loose soil deposits as determined by the University's Representative shall be cleaned out to firm undisturbed soil and backfilled with suitable material in accordance with these specifications. Street signs, site lighting and irrigation facilities which are to be salvaged shall be stockpiled for delivery to the University's Representative.

B. Grubbing shall consist of removal and disposal of all stumps and roots larger than 1" in diameter to a depth not less than 18" below any subgrade, bottom of trench or structure. All depressions excavated below the original ground surface for or by the removal of stumps and roots shall be refilled with suitable material and compacted to make the surface condition conform to the surrounding ground surface.

3.03 EXCAVATION

A. Excavation for the building shall be to a depth of 2.0' below the bottom of the footings and 5'-0" outside the perimeter of the building footprint.

1. When excavation has reached required sub-grade elevations, University's Testing Laboratory, will make an inspection of conditions. If unsuitable bearing materials are encountered at required sub-grade elevations, carry excavations deeper. Removal of unsuitable material and its replacement as directed by University's Representative will be paid on the unit costs basis established in the Contract.

2. Replace excavated soils with suitable sub-base material. Place fill materials in layers (lifts) not more than 8" in loose depth for material compacted by heavy compaction equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers.

a. Prior to compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density. Do not place fill material on surfaces that are muddy.
b. Place fill materials evenly adjacent to structures, piping or conduit to required elevations. Take care to prevent wedging action of fill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping or conduit to approximately same depth in each lift.

B. Excavation is unclassified, and includes excavation to sub-grade elevations indicated, regardless of character of materials and obstructions encountered.

C. Unauthorized Excavation consists of removal of materials beyond indicated sub-grade elevations or dimensions without specific direction of the University's Representative. Unauthorized excavation, as well as remedial work directed by the University's Representative shall be at Contractor's expense.

1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to the University's Representative.

2. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations or same classification, unless otherwise directed by the University's Representative.

D. Excavate material from existing planters and stockpile for use in future backfill of planters in a location designated by University's Representative.

E. Excavate material from paved areas and stockpile separately for use as fill material only within areas to be paved.

F. The tolerance for top surface of sub-grade shall be plus or minus 0.1'.

3.04 PREPARATION, PLACEMENT, COMPACTION OF OTHER FILL MATERIAL

A. The surfaces upon which fill is to be placed, as well as sub-grades of the areas left at existing grade, shall be plowed or scarified to a depth of at least 6", until the surface is free from ruts, hummocks, or other uneven features which would tend to prevent uniform compaction by the selected equipment.

B. When the moisture content of the sub-grade is below that required to achieve the specified density, water shall be added until the proper moisture content is achieved.

C. When the moisture content of the sub-grade is too high to permit the specified compaction to be achieved, the sub-grade shall be aerated by blading or other methods until the moisture content is satisfactory for compaction.

D. After the foundations for fill have been cleared, plowed, or scarified, they shall be disced or bladed until uniform and free from large clods, brought to the optimum moisture content and compacted to not less than 90% for pavement areas (vehicle traffic), as determined by the ASTM D1557-91 compaction test.

E. The selected soil fill material shall be placed in layers which when compacted shall not exceed 6" in thickness. Each layer shall be spread evenly and shall be thoroughly mixed during the spreading to promote uniformity of material in each layer.
F. When the moisture content of the fill material is below that required to achieve the specified density, water shall be added until the optimum moisture content is achieved.

G. When the moisture content of the fill material is too high to permit specified degree of compaction to be achieved, fill material shall be aerated by blading or other methods until the moisture content is satisfactory.

H. After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted to the following minimum standards:

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>MINIMUM % COMPACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Pads</td>
<td>95%</td>
</tr>
<tr>
<td>Pavement Areas (Vehicle Traffic)</td>
<td>90%</td>
</tr>
</tbody>
</table>

I. Compaction shall be undertaken with equipment capable of achieving the specified density and shall be accomplished while the fill material is at the required moisture content. Each layer shall be compacted over its entire area until the desired density has been obtained.

J. The filling operations shall be continued until the fills have been brought to the finished slopes and grades as shown on the Drawings. The filling operations at landscaped areas shall continue until fill has been brought to the finished slopes and grades as shown on the Drawings. Only material excavated from planter areas may be used for backfill in new planters.

K. All portions of the work shall be kept free of standing water at all times until all work specified herein is complete and the entire project covered by this contract has been accepted by the University's Representative.

L. The surface of all areas of earth and other materials shall be finished to a reasonably smooth and compact surface substantially in accordance with the surface lines and cross-sections shown, or the elevations indicated on the drawings, or as directed by the University's Representative. The degree of finish shall be that ordinarily obtainable from either blade grader or scraper operations, or by hand-shovel operation, as the Contractor may elect, subject to approval. During construction, existing graveled and paved surfaces shall be kept shaped and drained.

M. The tolerance for top of sub-grade shall be plus or minus 0.1'.

3.05 FINAL SUBGRADE PREPARATION

A. The finished subgrade, immediately prior to placing subsequent material thereon, shall have a relative compaction not less than 95% for a depth of 0.5', in accordance with Section 19 of California Standard Specifications, 1988 (CSS), except that testing will be in accordance with ASTM Designation D-1557 instead of California Test Method 216. The subgrade shall be free of segregated material and shall be smooth and true to 0.10 foot above or below the theoretical grading plane. No material shall be placed upon the sub-grade until the sub-grade meets the above requirements. It is also specified that no rocks or hard lumps of material exceeding 6" in diameter shall be within the upper 0.5' of the sub-grade and that the subsurface shall be clean and free of loose material prior to placing aggregate base.
B. All underground utilities shall be installed and approved prior to the placement of any layers of aggregate base.

C. Compaction of backfill around structures or in area too small for self-propelled equipment shall be obtained by use of mechanical or hand tampers to the specified density.

D. Backfill planters uniformly and compact to 85% in landscaped areas. Backfill shall be brought to the finished slopes and grades as shown on the Drawings.

3.06 TRENCHING AND BACKFILL

A. Trenching shall be in open-cut trenches to the lines and grades shown on the drawings. Trenching shall include removal of all materials encountered. Trenches shall have vertical walls for a minimum of 1’ over the top of pipe being installed.

B. Unsheathed trenches for pipes greater than 2” and less than 33” inside diameter shall be 8” wider on each side than the exterior diameter of the pipe barrel or as required by the pipe manufacturer. For pipes 2” or less, the width is optional. Where sheathing is required, the width of the trench shall be increased only sufficiently to accommodate the sheathing and timbers. The bottom of the trench shall be finished off with a firm bed without gravel or rocky projections and a true grade to fit the barrel of the pipe, and with joint holes dug with only sufficient space to permit proper jointing. If sub-grade material is rock or gravel too large to permit the forming of a proper and uniform bed for the pipe, the improper material shall be excavated to a depth of 4” below sub-grade and replaced with clean, sandy material compacted into place, or with crushed aggregate varying from No. 4 to ½” in size. In cases where the ground is too soft to furnish a firm support for the pipe at the prescribed grade, excavation shall be carried to an additional depth of 6” below the bottom of the pipe, and sub-grade consisting of clean, graded aggregate varying from 2” to ½” in size, shall be placed over the full width of the trench.

C. Bedding shall be a firm layer of sand bedding material. At least 3” of sand shall be placed beneath the outside diameter of the pipe. In addition, a minimum of 3” of sand shall be placed in contact with and beneath all pipe joints and couplings. The sand bedding material shall provide uniform support for the full length of the pipe to a width of at least one half of the outside diameter of the pipe.

D. Bed sewers under pavements and wrapped piping in sand prior to backfilling. Backfill to point 6” above pipe with sand.

E. When pipe or underground conduit with a protective wrapping is to be placed in the trench, sand only shall be used for bedding the pipe or conduit. The sand used shall be certified to have a minimum resistance of 5,000Ω (ohms) per cubic centimeter when wetted to any moisture content with distilled water and shall consist of clean, natural, washed-sand, hard and durable particles varying from fine particles to particles of such size that all will pass through a ⅜” screen, not less than 90% will pass through a ¼” screen, and not more than 25% will pass through a No. 50 screen.

F. After pipe lines in excavation have been installed and tested, backfill excavation to point 6” above pipe using sand, fine earth, or otously tamp. Except as hereinafter noted, backfill above 6” above top of pipe shall be made by using earth from excavation placed in layers of 8” maximum depth. Compaction of each successive layer will be made with mechanical compactor. Excavation fill material will not be wheel rolled or jetted.

G. Backfill shall be native material or approved imported material as specified hereinafter, it shall be free from organic material, rubbish or other substances which will prevent
compaction of the fill. Compaction of backfill to finish grade shall be done in a manner which will not injure or disturb the pipe or existing facilities. Backfill shall be placed around pipe and not dropped directly on the pipe.

H. Sand, when used, shall be clean, granular material with 100% passing the No. 4 sieve and not over 10% passing the No. 200 sieve.

1. **Initial Backfill (up to 6" over pipe)** shall be, compacted to 90% of the maximum density. This material shall be placed immediately after pipe joints have been completed, and shall be compacted by mechanical means. The material shall be installed in lifts not exceeding 6" in depth before compaction, with a difference in level on either side of the pipe not to exceed 6".

   a. Initial backfill for water and PVC drain facilities shall be river sand.

   b. Initial backfill for sewer and concrete drain facilities shall be crushed rock.

2. **Typical backfill from 6" above the pipe** shall be site-excavated material.

   a. The backfill shall be placed in lifts not to exceed 6", and shall be compacted by approved mechanical means to a minimum density of 90% at optimum moisture content.

   b. The completed backfill shall be brought to pavement sub-grade and be graded and ready to receive the required pavement section.

I. When the moisture content of the trench backfill or sand bedding material is below that required to achieve the specified density, water shall be added until the proper moisture content is achieved.

J. When the moisture content of the trench backfill or sand bedding material is too high to permit the specified degree of compaction to be achieved, the material shall be aerated by blading or other methods until the moisture content is satisfactory for compaction.

K. After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted. The minimum degree of compaction shall not be less than 90% of maximum dry density as determined by the ASTM D1557-9 compaction test, except that backfill within 2'-0" of final grade within pavement areas shall be compacted to a minimum degree of compaction of at least 95% of the maximum dry density in accordance with the above standard. Compaction shall be undertaken with equipment capable of achieving the specified density and shall be accomplished while the backfill material is at the required moisture content. Each layer shall be compacted over its entire area until the desired density has been obtained.

L. The filling operation shall be continued until the trench backfill has been brought to the finished slopes and grades as shown on the Drawings.

M. The sides of all excavations shall be supported in the manner set forth in the current rules, orders and regulations prescribed in the Construction Safety Orders of the Division of Industrial Safety of the State of California. Existing and new structures or utilities shall be protected fully from damage. During backfilling, the sheet piling and other timbering shall be withdrawn so as to prevent caving, lateral movement or flowing of the sub-soils, or damage to piping or other structures. No sheathing or timbering shall be left in the excavation.
Excavations for structures and trenches for piping shall be kept free from water until compaction backfills and structures and pipelines are complete to above water, safe from uplift and horizontal water pressure or leakage. The Contractor at all times shall have on the site sufficient pumping machinery for immediate use.

Water removed shall be disposed of in such a manner as to cause no injury to property nor be a menace to public health.

Any backfill placed under this contract which subsides or settles below the adjacent finished grade or paving level during the guarantee period shall be brought to grade by the Contractor by adding compacted backfill or additional paving in paved areas.

Any unsuitable material encountered within 2' below the subgrade or 2' below original ground, whichever is lower, shall be brought to the attention of and removed at the direction of the University's Representative and the additional excavation greater than that required for preparation of original ground or subgrade shall be computed and paid for at the contract unit price bid per cubic yard of roadway excavations.

The Contractor shall use extra care in excavating unsuitable material so as not to aggravate the condition. If, in the opinion of the University's Testing Laboratory, the Contractor methods for excavating are increasing the amount of unsuitable material required to be excavated, the University's Representative will require the Contractor to take the necessary steps to correct the condition.

Backfill to replace the unsuitable material removed as roadway excavation shall be placed and compacted to sub-grade as specified herein. Suitable backfill material shall be as specified in Part 2 of this section.

The selection of the proper backfill shall be at the discretion of the Engineer. Backfill will be paid for at the contract unit price. The pay quantity will be the same as that computed for unsuitable material excavated as roadway excavation as specified herein.

Grading operations shall be observed by University's Testing Laboratory.

Field density tests shall be made by the University's Testing Laboratory after compaction of each layer of fill. Additional layers of fill shall not be spread until the field density tests indicate that the minimum specified density has been obtained.

Earthwork shall not be performed without notification or approval of the University's Representative. The Contractor shall notify the University's Representative at least two working days prior to commencement of any aspect of the site earthwork.

If the Contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary readjustments until all work is deemed satisfactory, as determined by University's Representative. No deviation from the Specifications shall be made except upon written approval of the Engineer.
3.09 DESIGNATED DISPOSAL AREAS

A. Gravel, asphalt and cement rubble, grass strippings, utility debris and organic debris shall be removed from the University's site.

B. Excess native material shall be disposed of as directed by University's Representative.

END OF SECTION 31 00 00